A star (*) indicates that the Abstract deals with Apparatus and Instruments.

JUNE, 1935.

GENERAL PHYSICS.

ADSORPTION.

2319. Statistical Derivation of Langmuir's Adsorption Isotherm. R. H. Fowler. *Cambridge Phil. Soc., Proc.* 31. *pp.* 260–264, April, 1935.—Fermi-Dirac statistical methods lead to the following results: (*i*) for molecular adsorption of gases to solids (one molecule adsorbed per atom of solid surface), $\theta = Ap/(1 + Ap)$; (*ii*) for atomic adsorption of diatomic molecules (each molecule requiring two points of attachment to surface of solid), $\theta = (Ap)^{\frac{1}{2}}/[1 + (Ap)^{\frac{1}{2}}]$; (*iii*) for adsorption of competing molecules (molecular adsorption of gaseous mixtures), $\theta_1 = A_1p_1/(1 + A_1p_1 + A_2p_2)$ and $\theta_2 = A_2p_2/(1 + A_1p_1 + A_2p_2)$; in all cases, θ = fraction of surface of solid covered by adsorbed molecules, p = gas pressure in equilibrium with adsorbed layer and A is a function of temperature alone. The analyses involve the assumptions, not necessarily true, that the fields holding the adsorbed molecules are independent of temperature and that the adsorption of a molecule is independent of neighbouring adsorbed molecules. L. V. C.

2320. Absorption of Water Mists by Respirators. H. Engelhard and W. Stiller. *Kolloid Zeits.* 70. *pp.* 267–273, *March,* 1935.—The absorption of water mists of varying concentration and of water vapour by the granular active charcoal of a respirator was studied. Water vapour is adsorbed by the charcoal just like any other vapour, but at a relatively low rate. The mist-particles, however, are removed mechanically, the process being practically complete after passage through a few mm. of the charcoal (mean particle size 1–2 mm.); well-dried kieselgühr, a non-adsorptive material, behaves similarly in this respect. For any such filter there exists a mist particle-size which is most difficult to remove from the air, both larger and smaller droplets being trapped more completely. L. V. C.

2321. Sorption of Propyl and Butyl Alcohols by Silica Gel. A. G. Foster. *Roy. Soc., Proc.* 150*A. pp.* 77–83, *May* 1, 1935.—The sorption of normal and iso-propyl alcohols and normal butyl alcohol by silica gel has been investigated at 25° C. The isothermals are similar to those previously obtained for methyl and ethyl alcohol and all five show the same peculiar characteristics. A considerable fraction of the total sorption occurs at pressures below 0·1 mm. and the intermediate part of the isothermals is linear over a wide range of pressure and concentration. A small hysteresis area is found just before saturation, the extent of which does not vary appreciably with the different alcohols. The relative pressure at which the hysteresis phenomena occur diminishes from methyl to butyl alcohol, but the capillary radius calculated from these pressures by means of the Kelvin equation remains constant at about 15° Å. [See Abstract 4771 (1934).] AUTHOR.

2322. Exchange Reactions between Heavy Hydrogen and Hydrogen Adsorbed in Solids. A. and L. Farkas. *Faraday Soc., Trans.* 31. *pp.* 821–824, *May,* 1935.—It is shown that even thoroughly outgassed materials such as quartz vessels, platinum wires and the like contain a certain amount of hydrogen the presence of which can be demonstrated by exchange with heavy hydrogen. It is emphasised that this exchange reaction might affect the accuracy of kinetic experiments with heavy hydrogen. AUTHORS.

See also Abstracts **2375**, **2422**, **2694**, **2695**, **2770**, **2776**.

ATOMIC AND MOLECULAR STRUCTURE.

2323. Mass of the Neutrino. W. J. Henderson. *Cambridge Phil. Soc., Proc.* 31. *pp.* 285–290, *April*, 1935.—From experimental results on the shape of the upper portion of the continuous β-ray spectra of thorium C and thorium C″ the distribution of energy is deduced. This distribution is compared with Fermi's theory wherein the shape of the curve depends on the mass of the neutrino. The comparison supports Fermi's conclusion that the mass of the neutrino is zero or certainly not more than a very small fraction of the electronic mass. [See Abstract 218 (1935).] AUTHOR.

2324. Non-Adiabatic Character of Variations of Nuclear Charge. L. Goldstein. *Comptes Rendus*, 200. *pp.* 1294–1296, *April* 8, 1935.—In the experimental study of processes involving gain or loss of charges by the nucleus, due to radioactive or excited changes, the effect of the electrons surrounding the nucleus has been neglected. It is shown theoretically that this change of nuclear charge, in the case of emission of a charge ze, where z is a positive or negative integer, gives rise to a perturbation of the electronic system inducing a transition from the fundamental state of the atom, Z, where Z is the atomic number, to the same state of the atom Z–z. N. M. B.

2325. Nuclear Shells : Angular and Magnetic Momenta of Nuclei. P. G. Kruger. *Phys. Rev.* 47. *pp.* 605–610, *April* 15, 1935.—Marked regularities in the number of isotopes per atom, suggesting closed shells in the nucleus, have been followed in arranging the first 30 elements into an isotopic system, with proton and neutron shells. In order to correlate both the angular and magnetic momenta of nuclei, certain j values of the terms arising from the proton and neutron configurations are chosen as the deepest terms, and assuming that the j values of the lowest terms are added vectorially with the j's oppositely directed, all the observed i values are accounted for. Apparently the s states are exceptions to the general rule, and have their j's in the same direction. Nuclear magnetic moments are discussed from the viewpoint of proton and neutron shells in the nucleus. The generalised g-formula is used to calculate the proton and neutron contributions to the g-factor, and these two contributions are then combined by jj coupling to give the nuclear g-values. Magnetic moments of 2·7 and 1·75 nuclear magnetons for the proton and neutron, respectively, are used. The deepest proton and neutron terms fix the values of l, j, and s, hence no arbitrariness exists in the calculations. N. M. B.

2326. Disintegration of Boron by Slow Neutrons. B. Kurtchatow, J. Kurtchatow and G. Latychew. *Comptes Rendus*, 200. *pp.* 1199–1201, *April* 1, 1935.—Examination, by Wilson's method, of of the disintegration of B by slow neutrons shows that the emission of two heavy particles occurs. The result is discussed in connection with the reactions suggested by the author and others. W. E. P.

2327. Artificial Radioactivity Produced by Neutron Bombardment Without Capture of the Neutron. B. Kourtchatow, I. Kourtchatow, L. Myssowsky, L. Roussinow. *Comptes Rendus*, 200. *pp.* 1201–1203, *April* 1, 1935.—In studying the γ-rays of bromine, the authors have discovered the existence of a third product of life-period 36 hours. They consider this to be an unstable isotope Br^{78} which arises from Br^{79} by neutron bombardment without capture of the bombarding neutron. W. E. P.

2328. Disintegration of Nitrogen and Boron and Possible Emission of Deutons. E. Pollard and W. W. Eaton. *Phys. Rev.* 47. *pp.* 597–605, *April* 15, 1935.—An account is given of the technique of detecting nuclear particles by the use of a proportional counter, and its advantages and limitations are discussed. The counter was used to investigate the disintegration of N and B by α-particles. In the case of N no group which could be ascribed to deutons was found while for B the presence of a short range group of about the expected energy, first found by Heidenreich, was confirmed. The values of the magnetic deflections of particles from both elements were compared with those for known protons and deutons of the same velocity and shown to be protons in each case. Further evidence for resonance was found in the experiments on N and the work of Heidenreich and Paton confirmed in the experiments on B. AUTHORS.

2329. Nuclear Potential Barriers: Experiment and Theory. E. Pollard. *Phys. Rev.* 47. *pp.* 611–620, *April* 15, 1935.—The heights of nuclear potential barriers are derived from experimental data, corrected for nuclear motion and penetration through the barrier. Barriers differ markedly for different incident particles. It is shown that the heights of barriers to α-particles increase with atomic number and that the nuclear radius at the top is proportional to the cube root of the atomic weight. Values for corresponding barrier radii of the neutron and the radioactive elements agree with those given by Dunning and by Gamow. It is suggested that the attraction operative in α-particle collisions is only a second-order force and that the anomalies in proton barriers are due to a first-order force effective much further outside their tops. A method for obtaining information about this force is suggested. The energies of resonance levels are tabulated and an approximate linear increase with atomic number is discussed. AUTHOR.

2330. Artificial Radioactivity. H. Fahlenbrach. *Zeits. f. Physik*, 94. 9–10. *pp.* 607–620, *April* 16, 1935.—Using a brass Geiger-Müller tube counter with an Al window the positron activity produced in B, Al and N by bombardment with α-particles from ThB + C and Po is examined. The half-periods are found to be $N^{13}: 10 \cdot 73 \pm 0 \cdot 15$ m., $P^{30}: 2 \cdot 89 \pm 0 \cdot 14$ m. and $F^{17}: 1 \cdot 1$ to $1 \cdot 2$ m. Comparison of the positron emission with the proton emission shows that with increasing energy of the α-particle the latter decreases continually as the former increases. The resonance levels for neutron emission are, however, identical with those for proton emission. Comparison of the excitation curve for B with that obtained by Curie and Joliot indicates that the neutron emission all arises from a B^{10} disintegration. With nitrogen, induced radioactivity sets in when the α-particles have a range of 3·5 to 4 cm. of air at S.T.P. The activation of F^{17} produced by irradiation of material in air, is attributed to the intermediary effect of nitrogen which becomes embedded in the material by radioactive recoil. For α-particles of 8 cm. range the relative amounts of artificial radioactivity produced in B, N and Al are in the ratio 7·5 : 35 : 70. F. C. C.

2331. Nuclear Transformations of Beryllium and Boron, and the Masses of the Light Elements. M. L. E. Oliphant, A. E. Kempton and (Lord) Rutherford. *Roy. Soc., Proc.* 150. *pp.* 241–258, *May* 8, 1935.—If the mass of Be is 9·0155 and so > that of 2 α-particles and a neutron (8·0043 + 1·0080) by 0·0032 or about 3×10^6 V., its stability is difficult to explain. Reëxamination of the results of bombarding Be with protons (I), and H^2 (II), and of B with protons (III) shows that there result from (I) singly- and doubly-charged particles, both of range 7·4 mm., from (II) groups of singly-charged particles of ranges 1·6, 8, 14, and 26 cm., and doubly-charged particles of ranges 1 and 3 cm. and also neutrons, and from (III) a small group of range 4·40 ± 0·06 cm. The difficulties in explaining these results are almost entirely removed if it is assumed that a small error occurred in the original determination of the He^4–O^{16} ratio. When the masses affected by this have been corrected agreement between the calculated and observed energies is good for the following reactions explanatory of the observed results—for (I) ${}_4Be^9 + {}_1H^1 \rightarrow {}_4Be^8 + {}_1H^2$, and ${}_4Be^9 + {}_1H^1 \rightarrow {}_3Li^6 + {}_2He^4$; for (II) (the doubly-charged particles) ${}_4Be^9 + {}_1H^2 \rightarrow {}_3Li^7 + {}_2He^4$ (and not as at first suggested $\rightarrow {}_3Li^6 + {}_2He^5$); (for the singly-charged, of 1·6 and 14 cm. range), ${}_1H^2 + {}_1H^2 \rightarrow {}_1H^3 + {}_1H^1$; (of 26 cm.) ${}_4Be^9 + {}_1H^2 \rightarrow {}_4Be^{10} + {}_1H^1$; (of 8 cm.) ${}_4Be^9 + {}_1H^2 \rightarrow {}_4Be^8 + {}_1H^3$; and for the neutrons ${}_1H^2 + {}_1H^2 \rightarrow {}_2He^3 + {}_0n^1$, and ${}_4Be^9 + {}_1H^2 \rightarrow {}_5B^{10} + {}_0n^1$; for (III) ${}_5B^{11} + {}_1H^1 \rightarrow {}_4Be^8 + {}_2He^4$. The corrected masses thus deduced are—${}_0n^1$ 1·0083, ${}_1H^1$ 1·0081, ${}_1H^2$ 2·0142, ${}_2He^4$ 4·0034, ${}_3Li^6$ 6·0163, ${}_3Li^7$ 7·0170, ${}_4Be^9$ 9·0138, ${}_5B^{10}$ 10·0143, ${}_5C^{12}$ 12·0027. C. A. S.

2332. Electrolytic Concentration of Oxygen Isotopes. P. W. Selwood, H. S. Taylor, J. A. Hipple, Jr., and W. Bleakney. *Am. Chem. Soc., J.* 57. *pp.* 632–644, *April*, 1935.—Electrolysis of 117 l. of water down to 1 cc. yielded only a 10 % increase in O^{18} concentration. The ratio of specific rates of discharge of O^{16} and O^{18} is 1·01. The work is discussed in comparison with other reports and in connection with the probable rate-determining process. AUTHORS.

2333. Applications of Deuterium. F. G. Brickwedde. *Washington Acad. Sci., J.* 25. *pp.* 157–166, *April* 15, 1935.—An account is given of the differences between the biological, chemical and physical properties of H_2 and D_2 and their compounds, and of some applications of D_2. The large difference in mass of the two hydrogen isotopes has allowed a study to be made of the effect of mass, independent of chemical nature, upon equilibrium concentrations and rates of reaction. In certain instances the use of D_2 has enabled the hydrogen atoms taking part in chemical reactions to be distinguished from one another. In physiological chemistry this ability to tag H atoms should prove useful in that the rapidity with which a drug taken into the system is absorbed by the blood stream and then eliminated can be determined. D_2 has found important applications in the field of nuclear physics being more effective than α-particles and protons in rendering light elements radioactive. A large number of physical properties of H_2O and D_2O are tabulated, and reveal considerable differences which have not yet been quantitatively explained. This is also true of the physical properties of H_2 and D_2. In cases where the differences have been accounted for further knowledge concerning H_2 itself has been acquired. A comparison of the vapour pressures of H_2 and D_2 has disclosed that solid H_2 has an unusually large coefficient of expansion, and that for solid H_2 $C_p - C_v$ is greater than C_v itself. R. W. P.

2334. Protons and Neutrons in the Natural System of Elements. C. G. Bedreag. *Comptes Rendus*, 200. *pp.* 1197–1199, *April* 1, 1935.—A brief reference and discussion of the extrapolation to the regions $Z > 92$ and $Z < 1$ of the author's arrangement of the elements [see Abstract 5104 (1933)]. W. E. P.

2335. Pair Bond Theory of Valency. H. Lessheim and R. Samuel. *Indian Acad. Sci., Proc.* 1. *pp.* 623–662, *March*, 1935.—The method of molecular orbitals is interpreted as leading to an electron pair theory of valency in which chemical linkage is produced by the degeneracy due to the equality of the electrons, whilst the degeneracy of the nuclear field is reduced to an effect determining the polarity. It is claimed that spectroscopic evidence supports this view, and that this interpretation is mathematically equivalent to that which leads to the single electron bond theory, but that it avoids the additional assumptions necessary for this and for the octet rule. C. B. A.

2336. Bond Energies and Valency Angles in Simple Carbon Compounds. W. G. Penney. *Faraday Soc., Trans.* 31. *pp.* 734–746, *May*, 1935.—The variation of the energy of a polyatomic molecule with the bond angles as given by the formula of localised pairs affords a means of calculating some of the vibration frequencies of the molecule, and, alternatively the exchange integrals may be determined from the observed values of the frequencies. The substitution of the values thus found into the formula of perfect pairing, should give quite accurately the variation of the energy with the bond angle. As an example, the frequency V_2 of the methane molecule is used to determine some fundamental C–H exchange integrals, which are then employed to demonstrate that the most stable form of the CH_3 radical has a plane configuration. The heat of the reaction, $H + CH_3 \rightarrow CH_4$, is then calculated as 106 cal. approx., in satisfactory agreement with experiment. A rough calculation, along similar lines, is made of the valency angles in certain substituted methanes. It is shown that if some or all of the H atoms in CH_4 are replaced by other mono-valent groups, the resulting deviations from the tetrahedral angle are remarkably small, and can hardly exceed a few degrees. H. H. Ho.

2337. Magnetic and Raman-Spectra Evidence on the Structure of Complex Cyanides. D. M. Bose. *Indian Journ. Phys.* 9. *pp.* 277–286, *March*, 1935.—In a previous paper [see Abstract 998 (1931)] it has been shown from magnetic evidence that in the complex cyanides, the cyanogen groups are present as double molecules $(CN)_2$, which are linked to the central paramagnetic atom by single or double bonds. In the present paper it is shown that the Raman spectra of the complex cyanides can also be satisfactorily interpreted by means of the same structural formula. AUTHOR.

2338. Detection of Molecular Interactions by the Time of Relaxation of Polar Molecules. P. Girard and P. Abadie. *Comptes Rendus*, 200. *pp.* 1187–1189, *April* 1, 1935.—The proportional variation of τ with η/T and consequent constancy of a in the equation $\tau = 4\eta a^3/kT$ (where τ is the time of relaxation, η viscosity, a molecular radius, k Boltzmann's constant, and T absolute temperature), has been demonstrated for solutions of varying concentrations of a polar in a non-polar liquid, *e.g.*, an alcohol in benzene. The ratio, r, of the values of τ of the polar molecules in the diluted media to those in the pure liquid, when plotted against composition, give a bell-shaped curve. As such dilution only results in increasing the distance between the polar molecules, its effect on τ can only be due to molecular interactions, of which there must be two types, causing respectively increase and decrease in τ, the latter being a function of the moment per unit volume and molecular distance. Deductions as to a are also discussed. C. A. S.

2339. Directive Influence of Electric Moment on Substitution in the Benzene Ring. W. J. Svirbely and J. C. Warner. *Am. Chem. Soc., J.* 57. *pp.* 655–656, *April,* 1935.—A study of the relation between electric moment and directive influence for substitutions in the benzene ring leads to the generally applicable empirical rule : If a mono-substituted benzene derivative possesses an electric moment greater than ~ 2·07 D, a second group will be directed to the meta position ; if the moment is less than ~ 2·07 D, the second group will be directed to the ortho and para positions. The moment rule does not violate the principle of former polarity rules which were based upon a qualitative estimate of the polarity of bonds. Since the effective moment of a molecule may vary with concentration, nature of solvent, temperature, nature of reagent and the formation of intermediate complexes, one may expect to find cases in which these factors make an important contribution to the directive influence. AUTHORS.

2340. Theory of Free Radicals and Organo-Alkali Compounds. E. A. Hylleraas. *J. Chem. Phys.* 3. *pp.* 313–314, *May,* 1935.—The author analyses Nilsen's use of the Pauling and Wheland method in computing the electron affinities of free aromatic radicals [see Abstract 541 (1935)] and concludes that the whole treatment of the electron affinities of free aromatic radicals as given by Nilsen is unsatisfactory. [See following Abstract.] C. B. A.

2341. Theory of Aromatic Free Radicals. L. Pauling and G. W. Wheland. *J. Chem. Phys.* 3. *p.* 315, *May,* 1935.—The application of the valence bond and molecular orbital methods to computations of the electron affinity of a free radical is discussed. The authors agree with Hylleraas' criticism of Nilsen's use of the valence bond method (see preceding Abstract) and add further criticisms. C. B. A.

See also Abstracts **2337, 2420, 2421, 2494, 2497, 2553, 2563, 2573, 2574, 2575, 2578, 2579, 2585, 2604, 2616, 2622, 2644, 2701, 2713, 2736, 2738.**

COLLOIDS.

2342. Surface Conductivity at Solid-Liquid Interfaces. F. Urban, H. L. White and E. A. Strassner. *J. Phys. Chem.* 39. *pp.* 311–330, *March,* 1935.—Specific surface conductivities of Pyrex glass particles in KCl and NaCl solutions of concentration $1{\cdot}25 \times 10^{-4}$ M to 1×10^{-2} M are determined. The surface conductivities represent the same fraction of total conductivity as in a glass capillary of about 10μ diameter. An equation, based on the Stern double layer, for calculating specific surface conductivities is developed. The calculated values are in agreement with experiment; values calculated according to Gouy's theory are not. Evidence is adduced to show that (*a*) electroosmose may occur when $\zeta = 0$; (*b*) a sudden increase in sedimentation volume need not be due to " Hafteffekt " ; (*c*) the electroviscous factor contains more than one component. The thickness of the diffuse layer is calculated. AUTHORS.

2343. Magnitude of Surface Conductivity. J. W. McBain and J. F. Foster. *J. Phys. Chem.* 39. *pp.* 331–342, *March,* 1935.—Measurements demonstate the large surface conductivity per cm.^{2} exhibited by KCl solutions in contact with glass surfaces, and likewise by films of fatty acid at the air-water interface. The specific surface conductivity of close packed films of stearic acid is $3 \cdot 8 \times 10^{-8}$ mho, that for palmitic acid $4 \cdot 0 \times 10^{-8}$ mho, and that for oleic acid $8 \cdot 4 \times 10^{-8}$ mho. New designs of cells have been developed which permit a ready demonstration of these results. These results are much too high to be attributable solely to the mobile ions in the outer portion of the diffuse double layer. AUTHORS.

2344. Aggregation of Aerosols by Means of Sound Waves. O. Brandt and H. Freund. *Zeits. f. Physik*, 94. 5–6. *pp.* 348–355, *April* 2, 1935.—The coalescence of aerosols by sound waves of great intensity and suitable wave-length has already been shown by the authors [see Abstract 395 (1935)]. A magnetostriction sound source is again used and the behaviour of the particles is recorded by means of a microkinematograph. By measuring the rate of fall of the particles, the relation between their size and the amplitude of the sound is deduced approximately. The concentration of the particles before and after the influence of the sound is estimated and it is shown that, below a concentration of about 2×10^4 particles / cm.^{3} under given acoustical conditions, no coagulation is to be expected. H. J. H. S.

2345. Theory of Coagulation of Colloids and of Smokes: an Amendment. W. R. Harper. *Faraday Soc., Trans.* 31. *pp.* 774–775, *May*, 1935.—In a previous paper on this subject [see Abstract 3472 (1934)], a new mathematical treatment by the author led to a coagulation coefficient only one-quarter that derived by Smoluchowski. This result, it is now stated, was in error owing to a numerical slip; the ratio should have been three-quarters. Other conclusions remain as before. L. V. C.

2346. Viscometric Investigations on the Structure of V_2O_5-Sols. Part II. A. Rabinerson and G. Schumann. *Kolloid Zeits.* 71. *pp.* 87–94, *April*, 1935.—Gentle heating of concentrated (1–$1 \cdot 5$ per cent.) V_2O_5-sols at 50–80° C. for a short time causes first decrease and then accelerated increase of the viscosity, which finally exceeds that of the unheated sol. Boiling of the sols results in immediate increase of the viscosity to an extent increasing with the duration of boiling. All these changes in viscosity proceed mainly in the region of small pressures. Protracted boiling leads to unstable values of the viscosity which, owing to mechanical action, is markedly depressed. To explain these results, it is considered that heating of the sols produces at least four different superposed effects: dissolution of the colloidal particles, destruction of the regular structures, acceleration of the growth in length of the particles, and acceleration of the irregular coagulation. [For Part I see Abstract 4798 (1934).] T. H. P.

2347. Molecular Weights of Cellulose and Cellulose Derivatives. E. O. Kraemer and W. D. Lansing. *J. Phys. Chem.* 39. *pp.* 153–168, *Feb.*, 1935.—Critical discussion of previous estimates of molecular weights of cellulose by osmotic pressure, ultracentrifugal sedimentation and end-group analytical methods and comparison of these with values obtained by Staudinger viscosity methods or modifications of them. The extent of polymerisation of cellulose acetate and nitrate was found to be $2\frac{1}{2}$ to $3\frac{1}{2}$ times as great by the ultracentrifuge method as by Staudinger's viscosity method applied to the same samples. A. S. C. L.

2348. Viscosity of Very Dilute Solutions of Nitrocellulose in Ether-Alcohol Mixtures. J. Grévy. *Comptes Rendus*, 200. *pp.* 742–744, *Feb.* 25, 1935.—Staudinger's viscosity equation is tested with solutions of nitro-cellulose in ether-alcohol mixtures of various composition.

When the alcohol content is below 20 % the specific viscosity becomes smaller. A. S. C. L.

2349. Influence of Light upon Periodic Precipitates in Gelatinous Media. E. Duchemin. *Comptes Rendus*, 200. *pp.* 927–928, *March* 11, 1935.—Liesegang rings of silver chromate, phosphate and arsenate in gelatin sols are affected by illumination both before and during the precipitation. The effect of the light is not only upon the gelatin, as specific effects are found due to the nature of the kation. A. S. C. L.

2350. Method for Obtaining Metals in a Finely Divided State. B. Claus. *Zeits. f. techn. Physik*, 16. 3. *pp.* 80–82, 1935.—A method is described for producing emulsions, sols and fine powders in bulk from metals and metallic combinations by means of the piezo-oscillator. If the electrodes, and in particular the kathode, of an electrolytic cell are exposed during the passage of the current to strong h.f. oscillations, the metal which is being deposited is thrown back in a highly dispersed form into the liquid. A similar effect is obtained when a substance is precipitated by chemical action on a carrier plate subjected to the oscillations. The effects on Hg, Ag and Fe are shown in photomicrographs. G. E. A.

2351. Mechanism of Emulsification by Ultrasonic Waves. C. Bondy and K. Söllner. *Faraday Soc., Trans.* 31. *pp.* 837–843, *June*, 1935.—The emulsifying action of ultrasonic waves in oil/water systems is due to cavitation. Emulsification occurs when cavities collapse. It is shown that cavitation can be caused by sound waves and ultrasonics. The influence of gases upon cavitation is complex. Dissolved gases as nuclei favour the formation of cavities. The hydrostatic pressure exerted by gases is necessary for the collapse of cavities. A new and general method for the preparation of emulsions based on the collapse of cavities was found : the sudden condensation of vapours, such as steam, at the interface of two immiscible liquids rapidly causes strong emulsification. AUTHORS.

2352. Influence of Gases on Mercury Emulsions Prepared by Ultrasonic Waves. C. Bondy and K. Söllner. *Faraday Soc., Trans.* 31. *pp.* 843–846, *June*, 1935.—Mercury is emulsified by ultrasonic waves in the same way as by shaking. The mechanism consists in the bursting of bubbles of the second liquid coated with thin films of mercury. Adsorbed gases stabilise mercury emulsions. The concentration of the emulsions formed in different liquids depends upon the stabilising properties of the dispersion medium. AUTHOR.

See also Abstract 2467.

CRYSTAL STRUCTURE AND PROPERTIES.

2353. Calculation of the Energy and Elastic Constants of Heteropolar Crystals. V. Ždanow, A. Erschow and G. Galachow. *Zeits. f. Physik*, 94. 3–4. *pp.* 241–249, *March* 19, 1935.—The energy and the elastic constants of some crystals of alkaline halides are calculated on the basis of wave-mechanics, a certain assumption being made about the mutual compensation of the polarisation forces and the exchange forces of the second order. Proper functions and effective quantum numbers are used, which were determined by Slater according to the method of the " self-consistent field." The calculated results are tabulated and are found to be in satisfactory agreement with the experimental data in the cases where such are available. H. L. B.

2354. Theory of Ionic Fixation. T. Neugebauer. *Zeits. f. Physik,* 94. 9–10. *pp.* 655–661, *April* 16, 1935.—It is shown that the diminution of refraction observed in ionic crystals can be explained with help of a method worked out for the calculation of lattice constants with determination of the energy of polarisation. This follows because the electron cloud of the anion penetrates into the cloud of the kation and therefore is exposed to the action of a stronger field. The field calculated with the help of point charges is on the contrary of an order of magnitude too small for the explanation of the observed effect. An empirical formula of K. Fajans is deduced. J. J. S.

2355. Dynamics of Molecular Crystal Lattices. Part I. Neon. V. Deitz. *Frank. Inst., J.* 219. *pp.* 459–469, *April,* 1935.—In the equation for the complete lattice energy $\Phi_0 = \frac{1}{2}[-\Sigma c_{ij}/r_0^6 - \Sigma d_{ij}/r_0^8 + 12be^{-r/\varrho}] + E_0 = \Delta H$, where c_{ij} and d_{ij} are constants and $d_{ij} = 3c_{ij}^2/4e^2\alpha$, r_0 the equilibrium distance between the atoms, E_0 the zero point energy, α polarisability, ΔH the heat of sublimation per atom at 0°Abs., after showing that Slater and Kirkwood's approximation for c_{ij} [see Abstract 2367 (1931)] gives unsatisfactory results, the various constants are calculated for Ne and A by aid of Morgentau's method. The results for Ne and A are respectively $r_0 \times 10^8 = 3{\cdot}20$ and $3{\cdot}79$, $\alpha \times 10^{24} = 0{\cdot}39$ and $1{\cdot}63$, $\Delta H \times 10^{13} = 0{\cdot}293$ and $1{\cdot}262$, and $E_0 \times 10^{13} = 0{\cdot}098$ and $0{\cdot}131$. The dynamics of a small vibration of a face-centred lattice are then investigated by Born and Karman's method, and as applied to Ne and A give results for the maximum longitudinal frequency in reasonable agreement with those deduced from heat capacity data. C. A. S.

2356. Polyhedra of 120 Angles, of High Symmetry, Which Can be Inscribed in a Sphere. R. Reinicke. *Zeits. f. Krist.* 90. *pp.* 446–456, *May,* 1935. *In German.*—Methods are described by means of which polyhedra with the following numbers of angles, 30, 32, 36, 48, 54, 56, 60, 72, 84, 96, 108, 120, can be inscribed in a sphere. Extension is possible for the 126, 128, 134 polyhedra. F. I. G. R.

2357. Polyhedra Corresponding to Numbers 1 to 100 in Cubic Lattices. F. Haag. *Zeits. f. Krist.* 90. *pp.* 456–466, *May,* 1935. *In German.*—Corresponding to three distinct vectors in cubic arrangements, polyhedra 1 to 100 have been determined. Two different kinds of tetrahedral numbers are derived. F. I. G. R.

2358. Mixed-Crystal Formation and Lattice Constants of Silver-Copper Alloys. P. Wiest. *Zeits. f. Physik,* 94. 3–4. *pp.* 176–183, *March* 19, 1935.—Repetition of the determination of the Lattice-Constants isotherm for a Cu-Ag alloy. In contradistinction to earlier work, in the region of mixed crystals, no difference is found between single crystals and recrystallised polycrystalline material—for the inclined portion of the curve. For the horizontal part, the lattice constants are greater for single crystals than for the recrystallised polycrystalline substance. For decreasing temperature, there is an increase in the difference between the solubilities. F. I. G. R.

2359. Lattice Distortion in a Copper-Beryllium Alloy. G. W. Brindley and F. W. Spiers. *Leeds Philsoph. and Lit. Soc., Proc.* 3. *pp.* 73–80, *April,* 1935.—Intensities of X-ray reflections and atomic scattering factors have been measured for a powdered CuBe alloy containing 0·72 % Be by weight. The results are less than the calculated values by an amount which increases as the order of the spectrum increases. This difference is attributed to lattice distortion arising from (*a*) the filing process by which the powder was obtained, and (*b*) the fact that the Be atoms are smaller than the Cu atoms in the lattice. An estimate is made of the distortion due to filing from previous measurements. AUTHORS.

2360. Structure of Chromium, Molybdenum and Tungsten Hexacarbonyls. W. Rüdorff and U. Hofmann. *Zeits. f. phys. Chem.* 28. *Abt.B.*5. *pp.* 351–370, 1935.—From rotation photographs it is found that $Cr(CO)_6$, $Mo(CO)_6$ and $W(CO)_6$ are orthorhombic, with the following dimensions :—

	a	*b*	*c*
$Cr(CO)_6$	$11 \cdot 7_2$ Å.	$6 \cdot 2_7$ Å.	$10 \cdot 8_9$ Å.
$Mo(CO)_6$	$12 \cdot 0_2$ Å.	$6 \cdot 4_8$ Å.	$11 \cdot 2_3$ Å.
$W(CO)_6$	$11 \cdot 9_0$ Å.	$6 \cdot 4_2$ Å.	$11 \cdot 2_7$ Å.

The unit cell contains 4 molecules and the space group is C^9_{2v}. The positions of the metallic atoms are given. An attempt is made to fix the positions of the C and O atoms in all three salts, the deduction being based on assumptions regarding the dimensions and disposition of the (CO) groups. The calculated intensities for the suggested structure agree with the observed ones. J. T.

2361. C-Modification of the Sesquioxides of Neodymium and Lanthanum. K. Löhberg. *Zeits. f. phys. Chem.* 28. *Abt.B.* 5. *pp.* 402–407, 1935.—The lattice constant of Nd_2O_3 is established as $11 \cdot 05 \pm 0 \cdot 01$ Å by powder photographs. The same method is used for an approximate value for the lattice constant of La_2O_3, amounting to about $11 \cdot 4$ Å. F. I. G. R.

2362. Phosphides and Arsenides of Zinc and Cadmium. M. v. Stackelberg and R. Paulus. *Zeits. f. phys. Chem.* 28. *Abt.B.* 6. *pp.* 427–460, 1935.—The following compounds are concerned—Zn_3P_2, Zn_3As_2, Cd_3P_2, Cd_3As_2, ZnP_2, CdP_2, $ZnAs_2$. The Me_3X_2 types are typical coordination lattices ; each Zn(Cd) surrounded by 4 P (As). Each P (As) has 6 Zn(Cd) neighbours. Pseudo-cubic properties are indicated. Preliminary results are quoted for MeX_2 types. F. I. G. R.

2363. Lattice Dimensions of Lithium Hydride and Lithium Deuteride. E. Zintl and A. Harder. *Zeits. f. phys. Chem.* 28. *Abt. B.*6. *pp.* 478–480, 1935.—The salts LiH and LiD, *i.e.*, of isotopic hydrogen, have lattice dimensions at room-temperature, $4 \cdot 085 \pm 0 \cdot 001$ Å and $4 \cdot 065 \pm 0 \cdot 001$ Å respectively, viz., the appreciable difference of $0 \cdot 5$ %. The molecular volumes also differ by $1 \cdot 5$ %. H. H. Ho.

2364. Constitution of Lithium Nitride. R. Brill. *Zeits. f. Elektrochem.* 41. *pp.* 266–267, *May*, 1935.—Agreement is expressed with Zintl and Brauer's conclusion that lithium nitride crystals have a hexagonal structure [see Abstract 960 (1935)], rather than the cubic structure indicated by the author's earlier measurements. T. H. P.

2365. Structure of Methyl Ammonium Alum. H. Lipson. *Phil. Mag.* 19. *pp.* 887–901, *May*, 1935.—The question of the symmetry of the organic alums is discussed, and the crystal $NH_3CH_3Al(SO_4)_2 \cdot 12H_2O$, is considered in detail. Intensities of reflection of X-rays, estimated from oscillation photographs, show that the structure is not similar to that of potash alum, and the correct structure is deduced. The positions of the light carbon and nitrogen atoms are not, however, definitely indicated, though considerations of space suggest that the group NH_3CH_3 is spherical. The structure differs essentially from that of potash alum in having direct bonds from the SO_4 groups to NH_3CH_3. There are also geometrical differences. It is suggested that the two alum structures may be distinguished by their external forms. This is supported by the X-ray data from $KCr(SO_4)_2 \cdot 12H_2O$, $KAl(SeO_4)_2 \cdot 12H_2O$, and $CsAl(SO_4)_2 \cdot 12H_2O$. Further tests are suggested. AUTHOR.

2366. X-Ray Investigation of Crystals of Anthranilic Acid. M. Prasad and M. R. Kapadia. *Indian Journ. Phys.* 9. *pp.* 239–243, *March*, 1935.—The paper describes the preliminary results of an X-ray investigation of the crystals of anthranilic acid. The substance crystallises in two modifications which differ in density. The dimensions of the unit cell have been found to be different in the two cases and while one belongs to the space group Q_h^{11}, the other belongs to Q_h^5. The number of molecules per unit cell in each case is eight. AUTHORS.

2367. Space Group and Atomic Arrangements in Anthraquinone Crystals, Part I. K. Banerjee and B. C. Guha. *Indian Journ. Phys.* 9. *pp.* 287–294, *March*, 1935.—Oscillation photographs of meso-anthraquinone have been taken by a camera of good resolving power ; *hko* planes with $h + k$ odd do not reflect and goniometer measurements show the existence of a centre of symmetry. The space-group is therefore $D_{2h}\ p\ \mu\mu\nu$ (V_h^{13} according to Schönflies notation). AUTHORS.

2368. Structure of Benzoquinone. J. M. Robertson. *Roy. Soc., Proc.* 150*A*. *pp.* 106–128, *May* 1, 1935.—Intensity measurements on an absolute scale have been made for about 70 reflections from four different zones. The crystal is monoclinic, space group $P2_1/a$, with two centro-symmetrical molecules in the unit cell. The structure shows that the planar molecules are nearly parallel and lie almost in the $(20\bar{1})$ plane. The molecular dimensions and orientation have been determined. The ring is not a regular hexagon, owing to the stabilisation of the double bonds by the divalent oxygen groups. The $C - C$ distance is about 1·5 Å, $C = C$ about 1·32 Å and $C = O$ about 1·14 Å. The internal ring angle between single carbon bonds is 109°, and between double and single bonds 125°. These figures are approximate, but the distortion of the ring out of the regular hexagon structure seems quite definite and can be directly observed without measurement on one of the electron density maps. The minimum intermolecular distance between O atoms is 3·62 Å, between O and C 3·36 Å, and between C and C 3·44 Å. Coordinates of the atoms in the asymmetric crystal unit are given. AUTHOR.

2369. Structure of Insulin. Dorothy Crowfoot. *Nature*, 135. *pp.* 591–592, *April* 13, 1935.—From oscillation photographs it is deduced that the structure of insulin may be referred to a simple rhombohedral cell with $a = 44 \cdot 3$ Å and $\alpha = 115°$. Referred to hexagonal axes the dimensions are $a = 74 \cdot 7$ Å and $c = 30 \cdot 6$ Å. The structure may also be described in terms of a pseudocubic body-centred cell with $a = 47 \cdot 7$ Å and $\alpha = 103° 6'$. The space group is R3. The crystal unit cell probably contains one molecule but the possibility of its containing 3n sub-molecules is not excluded. The structure is of an eight coordination type. It is suggested that the 3 atoms of Zn present per molecule of insulin are required to bind the molecules into nets parallel to the *c* plane. A structure for pepsin is also suggested. J. T.

2370. Structures of Sym-Diiodoethane and Sym-Diiodoethylene. H. P. Klug. *Zeits. f. Krist.* 90. *pp.* 495–507, *June*, 1935.—*s*-$C_2H_4I_2$ and *s-trans*-$C_2H_2I_2$ are isomorphous, have two-molecule monoclinic cells, and the space group C_{2h}^5. They are pseudo-orthorhombic with the diffraction effects showing no deviations from orthorhombic symmetry. As a result the four-molecule orthorhombic cells based on space group V_h^{18} are of much greater interest. Their dimensions are:

$$C_2H_4I_2 \quad a_0 = 7{\cdot}582\ \text{Å} \quad b_0 = 12{\cdot}897\ \text{Å} \quad c_0 = 5{\cdot}810\ \text{Å},$$
$$C_2H_2I_2 \quad a_0 = 7{\cdot}280\ \text{Å} \quad b_0 = 13{\cdot}310\ \text{Å} \quad c_0 = 5{\cdot}553\ \text{Å}.$$

The iodine atoms in the orthorhombic cells of both compounds are located at the positions:

$$0uv;\ \tfrac{1}{2}, \tfrac{1}{2} - u,\ v;\ \tfrac{1}{2}, u, v + \tfrac{1}{2};\ 0, \tfrac{1}{2} - u, v + \tfrac{1}{2};$$
$$0\bar{u}\bar{v};\ \tfrac{1}{2}, u + \tfrac{1}{2},\ \bar{v};\ \tfrac{1}{2}, \bar{u}, \tfrac{1}{2} - v;\ 0, u + \tfrac{1}{2}, \tfrac{1}{2} - v;$$

where $u = 0{\cdot}145 \pm 0{\cdot}005$ and $v = 0{\cdot}27 \pm 0{\cdot}01$. The closest distances of approach between two iodine atoms were found to be 3·97 Å in $C_2H_4I_2$ and 3·94 Å in $C_2H_2I_2$, values in excellent agreement with the results found in other crystals. AUTHOR.

***2371. Change of Structure of Crystals in the Electric Field. A. Német.** *Helv. Phys. Acta*, 8. 2. *pp.* 117–151, 1935. *In German.*—A further account is given of experiments on the change of structure of crystals in the electric field [see Abstract 1374 (1935)]. A technical X-ray tube with copper anti-kathode was used in the investigation. In the present paper a description is given of various portions of the apparatus employed, including the ionisation chamber and the spectrograph. This is followed by a calculation of the quantum oscillations. J. J. S.

2372. Geometry of Plastic Deformation of Rock-Salt Crystals. A. Komar. *Zeits. f. Krist.* 90. *pp.* 467–469, *May*, 1935. *In German.*—It appears from X-ray photographs and calculations that the "brushes" seen on Laue photographs of deformed rock-salt crystals are caused by macroscopic bending of the lamellæ, rather than by local bending at their boundaries. F. I. G. R.

2373. Precision Photographs by Debye-Scherrer Methods. M. Straumanis and O. Mellis. *Zeits. f. Physik*, 94. 3–4. *pp.* 184–191, *March* 19, 1935.—Experiments to test the accuracy of a Debye-Scherrer camera, of diameter 57·4 mm. for the determination of glancing angle and lattice constants. It appears that the results are practically as good as those obtained by the best precision methods. F. I. G. R.

***2374. Small X-Ray Apparatus for Crystal Analysis. W. E. Schmid.** *Zeits. f. techn. Physik*, 16. 4. *pp.* 115–119, 1935.—A small portable X-ray apparatus is described which is intended for use in the practical application of the methods of X-ray crystal analysis. The tube is of the hot-kathode type and is provided with three Lindemann windows. Its output is about 450 W. The tube may be used either horizontally or vertically. Several automatic safety devices are incorporated. The apparatus is made by Siemens. J. T.

See also Abstracts 2562, 2624, 2628, 2698, 2699, 2700, 2734, 2743, 2745, 2751, 2752.

DENSITY.

***2375. Density and Adsorption in the Region of the Critical Temperature: System Dimethyl-Ether-Alumina. J. Edwards and O. Maass.** *Canad. J. of Research*, 12. *pp.* 357–371, *March*, 1935.—An apparatus and an experimental procedure for simultaneously determining the density and adsorption of liquids, vapours and gases in the region of the critical temperature are described. Measurements of adsorption and density of dimethyl ether through the temperature range 124–135° C. are given for the liquid, vapour and gas. Adsorption of the liquid does not occur below 124° C. but beginning at this temperature, it rapidly increases to a maximum, beyond which the adsorption curve resembles a normal isobar. It is shown that the apparent adsorption cannot be ascribed to a lag in the critical temperature of liquid held in the pores, and further that an absurd value for the density of such liquid must exist to account for the total adsorption observed. Hysteresis effects of a complex nature are noticed, and these are discussed from the point of view of the hypothesis that: " there is an essential difference, other than concentration, between a liquid and a highly compressed gas." AUTHORS.

See also Abstracts **2629, 2645.**

DIFFUSION AND OSMOSIS.

2376. Friction, Heat Conduction and Diffusion in Gaseous Mixtures. Parts XXXI to XXXIV. Diffusion Constants of Gases. M. Trautz and W. Müller. *Ann. d. Physik*, 22. 4. *pp.* 313–374, *March*, 1935.—Maxwell's diffusion equation is examined and it is shown that the diffusion coefficient defined by Fick only applies to that case of stationary diffusion in which there is a linear concentration gradient. An expression is derived for the most general case of stationary diffusion, which only differs by a factor, equal to the ratio of the total pressure of the gas to atmospheric pressure, from the coefficient as defined by Maxwell. The mixing proportions of two gases throughout the length of a diffusion cylinder are calculated and plotted. The dependence of the coefficient on these proportions is discussed. It is shown, both theoretically and from the results obtained for the diffusion constant, that the evaporation method is subject to a number of errors, the magnitude of which is inversely proportional to the length of the diffusion cylinder. These errors can thus be eliminated by using cylinders of various lengths and extrapolating to the case in which the cylinder is infinitely long. All existing values obtained for gaseous diffusion constants by the evaporation method are examined and corrected in the light of the foregoing. No definite influence of the relative proportions of gases in the mixture is apparent from these corrected values. The diffusion coefficients of CCl_4 in O_2 and acetone in H_2 are measured at 23° C. and found to be 0·0691 and 0·3908 respectively. Alternative methods which have been employed for the determination of diffusion constants and the results obtained are discussed. [For Part XXX see Abstract 1470 (1935).] R. W. P.

2377. Diffusion of Hydrogen in Palladium. B. Duhm. *Zeits. f. Physik*, 94. 7–8. *pp.* 435–456, *April* 8, 1935.—Measurements of the diffusion of hydrogen in palladium by different methods show that in the concentration ranges 0 to 30 and 800 to 1000 volumes of H_2 at N.T.P. per volume of metal, solution phases are formed in which free diffusion can occur. The diffusion coefficient is determined for both ranges and found to be the same for both. The mobility in an electric field is also measured. From the ratio of mobility to diffusion the effective charge on the protons in solution in palladium is deduced and is found to be only a small fraction (about 1/500) of the elementary charge. L. A. W.

2378. Diffusion of Gases Through Metals. C. J. Smithells and C. E. Ransley. *Roy. Soc., Proc.* 150. *A. pp.* 172–197, *May* 1, 1935.—The rate of diffusion of H_2 through Cu, Ni, Fe and Mo, and of N_2 through Mo has been determined over a wide range of temperature and pressure. The effect of temperature is satisfactorily represented by the exponential term in Richardson's equation. The effect of pressure is only approximately represented by the equation $D = k\sqrt{P}$, the deviation from this relation being most marked at low pressures. All published data are examined and found to exhibit the same deviation. An allowance is made for the fraction of the surface covered by adsorbed gas, by introducing the Langmuir isotherm, and the equation $D = k\sqrt{P}(aP(1 + aP)\ )$ accurately represents the experimental results. The effect of adsorption on diffusion is emphasised, and it is shown that activated adsorption is necessary for diffusion to take place. Adsorption coefficients can be determined from diffusion measurements by means of the above equation. No diffusion of A or He could be detected with any metal, and if it does occur the rate is not more than 10^{-5} times the rate for the common gases. The rate of diffusion of H_2 through a single crystal of Fe is the same as through ordinary fine-grained Fe. AUTHORS.

2379. Osmotic Behaviour of Dissolved Substances as a Function of the Specific Interaction between Solvent and Solute. K. Fredenhagen. *Phys. Zeits.* 36. *pp.* 321–335, *May* 1, 1935.—A mechanism of osmotic phenomena based upon interaction between solvent and solute in constant or multiple proportions is developed and exemplified in the case of various types of solvents. J. S. G. T.

See also Abstracts 2722, 2723.

ELASTICITY AND PLASTICITY.

2380. Constrained Elasticity and Equations of Elasticity for Solids Whose Baricentric Fibre is Plane. E. Volterra. *Accad. Lincei, Atti,* 20. *pp.* 463–467, *Dec.* 16, 1934, *and* 21. *pp.* 14–19, *Jan.* 6, 1935.—Mathematical apparatus is described for treating problems of the elastic equilibrium of isotropic bodies, in which the plane sections normal to the mean baricentric curve remain plane under deformation. A special coordinate system is described in which the *u*-axis is the mean curve and the other two axes are the principal normal and binormal of this curve at any point, and expressions are obtained in these coordinates for the components of the elastic deformation and for the energy function. The special case where the baricentric curve or fibre is plane is treated in more detail and the general elastic equations for this case are deduced. A. J. McC.

2381. Displacement and Deformation of an Elastic Bar. E. H. Bateman. *Phil. Mag.* 19. *pp.* 1011–1015, *May,* 1935.—The author has previously shown that the internal stresses in a network of elastic bars under the action of known external forces can be obtained directly from the partial derivatives of the strain energy or work of deformation with respect to the unknown moments [see Abstract 2303 (1934)]. If the deformation is caused by known displacements instead of, or in addition to, known external forces, a similar analysis is now shown to be applicable provided the work of displacement can be expressed in terms of the unknown moments. J. S. G. T.

2382. Influence of Concentration and Solute on Compressions of Aqueous Solutions. R. E. Gibson. *Am. Chem. Soc., J.* 57. *pp.* 284–293, *Feb.,* 1935.—Measurements at 25° C. of compressions up to 1000 bars of solutions of 16 salts (mainly of K) and of acetic acid were made over the whole concentration range; the results are generally expressible as a linear relation between the apparent compression of the salt and the square root of the volume concentration. The compression of water, in aqueous solutions, is affected by the size and charge of the solute ions, while Tammann's " effective pressure " is proportional to the product of the concentrations of water and salt. An equation for the volume of a solution as a function of pressure, making allowance for this effective pressure, gives values of compressibility in close accord with those derived from sound-velocity measurements. Acetic acid solutions show anomalous behaviour if bulk rather than molal-concentrations are considered. L. V. C.

2383. Plastometric Investigations on Highly Consistent Substances. Part IV. G. Ungar. *Kolloid Zeits.* 71. *pp.* 16–22, *April*, 1935.—This paper deals with the determination and evaluation of the shearing curves for clay slimes. Various characteristics of these clay slimes are described such as the tendency to form surfaces of slip or to solidify ; the influence of mechanical pre-treatment and ease of drying, etc., are described and discussed. It is shown that strength can be determined independently of apparatus dimensions, but dependent on the clay content of the slime. The characterisation of clays is discussed and proposals for their differentiation submitted. [For Part III see Abstract 1957 (1935).] H. H. Ho.

2384. Photoelastic Study of Stress Due to Impact. Z. Tuzi and M. Nisida. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 566. *pp.* 277–309, *April*, 1935. *In English.*—The paper describes developments of the authors' method of photoelastic study of stress distributions by the kinematographic method [see Abstract 1293 (1930)] and states that the exposure time has been shortened to about 1/50,000 sec. A carbon lamp in conjunction with a heavy current and a red filter of narrow band were used as light source. Stresses due to a vibrating cantilever and impacts of a beam and rings were investigated using phenolite models. The paper is copiously illustrated. R. L.

***2385. Eddy-Current Brakes. E. F. Powell and S. W. Gough.** *Journ. Sci. Instruments*, 12. *pp.* 161–165, *May*, 1935.—A study of the properties of eddy-current brakes suggests some lag effect in the action of eddy currents which increases with frequency. Using this conception, a theory is given to account for the results obtained and to evolve a convenient mode of presenting them graphically. [See also Abstract 4849 (1934).] AUTHORS.

2386. Molecular Tensile Strength of Liquids. J. Meyer. *Zeits. f, phys. Chem.* 173. *Abt.A.* 2. *pp.* 106–114, 1935.—The Smekal conception of molecular tensile strength developed in connection with solid substances, is now applied to liquids and it is shown that this tenacity of liquids may be observed under certain experimental conditions after removal of the free surface. The influence of temperature on the molecular tenacity is discussed from the P-V-T diagrams and experimentally demonstrated. Data are given for water, ethyl ether, methyl ethyl ether, *i*-propylethane, benzene and ethyl alcohol. H. H. Ho.

See also Abstracts 2629, 2660.

GRAVITATION.

See Abstract 2414.

HYDRODYNAMICS AND AERODYNAMICS.

2387. Vortex Decay in Turbulent Regions. G. D. Mattioli. *Accad. Lincei, Atti,* 21. *pp.* 87–92, *Jan.* 20, 1935.—The turbulent motion of a liquid is of two distinct types—bounded and free. The first type takes place when the liquid is enclosed inside finite boundaries and in this case the variation of the moment of momentum of each element of volume due to the turbulent motion is neutralised by a suitable couple; the second type takes place when the boundaries are at an infinite distance and here the above couple is identically zero. That the couple must exist in the first case is obvious from the consideration that at the finite boundaries vortices are created, which are continuously projected into the mass of liquid, and this increase in vortex strength at each point must be dissipated in the case of steady motion by a couple of the type stated. A. J. McC.

2388. Resistance to the Rotation of a Disc Immersed in a Fluid. S. Goldstein. *Cambridge Phil. Soc., Proc.* 31. *pp.* 232–241, *April,* 1935.—The turbulent motion of a viscous fluid due to the rotation of an immersed plane disc is investigated in relation to the work of Kármán and of Cochran [see Abstract 3523 (1934)], using a revised form of the expression for the distribution of the mean velocity near a smooth wall. The results obtained are shown to be in satisfactory agreement with experimental data. N. M. B.

2389. Fluid Flow Behind a Sphere. A. Foch and C. Chartier. *Comptes Rendus,* 200. *pp.* 1178–1181, *April* 1, 1935.—The dead-water region behind a fixed spherical obstacle immersed in a flowing fluid is discussed. Two distinct regions in the disturbed zone are distinguished; the first, called the eddy region, is situated immediately behind the obstacle and is on the average stationary. The second region, called the wake, participates in the general motion of the fluid. An attempt is made to follow the variation of resistance to the flow with changes in the kinematics of the flow by means of stereoscopic time photography. The results are given for velocities of flow less than, equal to or greater than 90 cm./sec. ($R = 1 \cdot 25 . 10^5$). In the first case the dead-water is made up almost entirely by the wake, which contains spiral vortices, in the second case, when $R = 130{,}000$, an eddy region suddenly appears, limited by a cone of angle 55°, whilst in the third case the eddy region is elongated and its vertex becomes flattened. G. F. P. T.

See also Abstracts **2386, 2464.**

KINETIC THEORY OF MATTER.

2390. Brownian Motion of an Axially-Symmetrical Particle. G. Krutkow. *Comptes Rendus de l'Acad. des Sciences, U.S.S.R.* 1. *pp.* 366–371, *Feb.* 21, 1935. *In German.*—In a previous paper [see Abstract 4048 (1934)] the author has discussed mathematically the Brownian rotatory motion of an axially symmetrical particle in the special case where the angular velocity is about the axis of symmetry. The discussion is now generalised for the case of rotation about any axis. J. S. G. T.

See also Abstracts **2623, 2646.**

LENGTH (STANDARDS, MEASUREMENTS, APPARATUS).

***2391. Improved Dowling Ultramicrometer. G. Gustafsson.** *Ann. d. Physik,* 22. 5. *pp.* 507–512, *April,* 1935.—Describes a modification of the original Dowling ultramicrometer circuit [see Abstract 757 (1921)] which renders the instrument less sensitive to capacity effects due to the presence of the observer. The modified circuit consists of a leaky-grid arrangement of the oscillating valve having both grid and anode circuits tuned with variable inductive coupling between them. Utilising the capacity change in a small parallel-plate condenser for measuring small displacements a sensitivity of 36 mA/cm. variation of capacity can be attained, corresponding to an accuracy of length measurement of 10^{-9} cm. H. B.

***2392. Adjustment of Lath Alidades. K. Ulbrich.** *Zeits. f. Instrumentenk*, 55. *pp.* 166–168, *April*, 1935.—Horizontal transverse laths must satisfy accurately two conditions (1) horizontality, and (2) normal to the line of vision. Condition (1) is fulfilled by an adjustable stop level which is controlled by the instrument with a horizontal needle. For condition (2) the lath alidade used is mostly so constructed that a correct setting of the lath is shown by the collimator on the instrument. A formula is given for an approximate calculation of the error with cross laths. To obtain an accuracy of $1 : 2 \times 10^4$ in distance the lath must be set to 0°·5. Other sources of error can also occur. Various types of alidades are considered which possess (1) displacement of the metal diaphragm, (2) rotation of the axis of rotation of the alidade, and (3) rotation of the axial arm of the alidade carrier. It is shown that errors can be reduced in these ways. R. S. R.

MATHEMATICAL METHODS, THEORY OF MEASUREMENTS, UNITS AND DIMENSIONS.

2393. Random Fluctuations, Persistence and Quasi-Persistence in Geophysical and Cosmical Periodicities. J. Bartels. *Terr. Mag.* 40. *pp.* 1–60, *March*, 1935.—The statistical aspects of the application of harmonic analysis are discussed on the basis of recent developments in the theory of probability. Between the two extreme cases of random fluctuations and persistent waves, hitherto discussed exclusively, the intermediate case of quasi-persistence is introduced and recognised as a common phenomenon in the time-functions of meteorology, geophysics, and cosmical physics. Statistical methods, based on the conception of the harmonic dial, are given for dealing with quasi-persistence and its effect on tests for persistent waves, and they are generalised for the case of periodicities of other form than that of the sine-wave. Typical examples are given illustrating various forms of random fluctuations, quasi-persistence, and persistence, as well as questions related to harmonic analysis, such as the periodiogram, non-cyclic change, curvature-effect, equivalent length of sequences, effective expectancy, random walk, interference, and the infective property of quasi-persistence on adjacent periods. AUTHOR.

2394. Application of the Probability Calculation of Finite Samples. H. Blume. *Zeits f. Physik*, 94. 3–4. *pp.* 192–203, *March* 19, 1935.—The author refers to an earlier paper [see Abstract 103 (1935)] in which the mathematical problem of calculation for finite samples was investigated and in which he found that the Mises numerical operations of mixing, separation, connection and regularity were valid. In this paper the calculation is applied to the physical problem of repetition processes. It is established that an elementary conclusion must be obtained if the mathematical calculation of finite samples for it is to be valid and this conclusion can be found by a simple mathematical equalisation principle. This leads to the definition of a physical probability in the form that a quantity of repetition processes yields a physical probability if an elementary series can be arranged which satisfies the conditions of a W-series. Its usefulness and advantages are set up in conjunction with the application to repetition processes. Finally its improvement on the statements by Reichenbach and Mises and the alternative procedure of Popper are discussed. R. S. R.

2395. Tests of Significance, Treated by the Theory of Probability. H. Jeffreys. *Cambridge Phil. Soc., Proc.* 31. *pp.* 203–222, *April*, 1935.—The following matters are discussed: (1) two sets of data by observation give slightly different estimates of the true value, and it is desired to know whether the difference is significant; (2) there are two different ways of measuring a quantity, and it is desired to ascertain whether there is any systematic difference between the results; (3) possible failure of the normal law of errors; (4) the rejection of observations; (5) measurement when the standard errors are previously unknown; (6) correlation; (7) periodicity. J. S. G. T.

2396. Errors of First and Second Category in the Verification of Hypotheses on Poisson's Law. J. Przyborowski and H. Wileński. *Comptes Rendus,* 200. *pp.* 1460–1462, *April* 24, 1935.—An elementary law of probabilities $p\ (\Sigma)$ is considered, where $\Sigma\ (x_1, x_2, \ldots x_n)$ indicates a point in space of n dimensions, representing the observed fact. The theory of the verification of hypotheses distinguishes simple hypotheses h, where $p\ (\Sigma)$ is specified by h, and compound hypotheses H, where $p\ (\Sigma)$ is not completely specified by H. Each compound hypothesis includes a class of simple hypotheses. This theory investigates two classes of errors, those committed in (1) rejecting a true hypothesis, and (2) accepting a false hypothesis. The errors in question can be controlled by means of a critical region where one always rejects the observed fact falling within this region. In the paper the upper limits of the probability of errors in these two classes is established where the observed fact obeys Poisson's law $p\ (x) = e^{-m}\ m^x/x!$ [See Abstract 61 (1934).] R. S. R.

MECHANICS, CLASSICAL.

2397. Rational Mechanics for Euclidean Connections, and a Necessary Form for all Physical Laws. Loiseau. *Comptes Rendus,* 200. *pp.* 1018–1020, *March* 18, 1935.—The form of the equations of mechanics defined by a Euclidean connection is obtained. This form is a necessary one so long as it is assumed that a set of Euclidean axes can be defined at each point of space. G. C. McV.

2398. Proposal for the Revision of the Force Concept in Macro-Mechanics. F. Requard. *Zeits. f. Physik,* 94. 7–8. *pp.* 544–548, *April* 8, 1935.—It is suggested that force should be defined in terms of the deformation of a solid body produced by the force. Defined in this way the force acting would, it is claimed, be independent of the reference system, the difference between gravitational and inertial mass would be given due recognition, and the law of motion under a force would become, "deformational" force equals inertial mass times dynamical acceleration where the latter does not include the gravitational acceleration of the body. The law in this form would be susceptible of direct experimental test. W. S. S.

2399. Effect of Pivoting Friction in the Collision of Elastic Bodies. Z. Horak. *Comptes Rendus,* 200. *pp.* 897–899, *March* 11, 1935.—Applies the author's general theory of impact [see Abstract 1758 (1929)] to the case of two imperfectly elastic and perfectly rough spheres, to obtain the change in spin during impact. W. S. S.

***2400. Piezoelectric Accelerograph. H. Gondet and P. Beaudouin.** *R.G.E.* 37. *pp.* 499–508, *April* 20, 1935.—The detector is made of two small discs of quartz separated by a metal foil connected to the grid of an " electrometer valve " [see Abstract 978 (1935)]. Two springs press the detector between a support rigidly fixed to the test machine, and an inert mass, the springs being strong enough to maintain the quartz permanently in compression. When the test machine is subjected to accelerations, the pressure between the inert mass and the quartz varies, and this alters the potential of the grid of the electrometer valve. The resulting changes in plate current are amplified and made to work an electromagnetic oscillograph. The sensitivity of the detector can be adjusted by varying a condenser connected to its electrodes. The range of accelerations measurable extends from a few 0·001 g to a few 10 g and the vibrations observable range in period from a few milliseconds to a few seconds. P. V.

See also Abstracts 2413, 2660.

MECHANICS, QUANTUM.

2401. Class of Solutions of Dirac's Equation. D. M. Wolkow. *Zeits. f. Physik,* 94. 3–4. *pp.* 250–260, *March* 19, 1935.—In the first part a solution is given for the case of a sinusoidal field. In the second case the author deals with the case where the external field consists of polarised waves advancing in a definite direction and consisting of a set of electromagnetic waves whose frequency and initial phases are specified. H. L. B.

2402. Dirac's Theory of " Holes " and the Velocity of Light in Vacuo. R. Peierls. *Physica,* 2. *pp.* 399–402, *April,* 1935. *In German.* —In Dirac's theory of " holes " it has been found that an infinite dispersion should be expected when light travels through a vacuum. This appears to be a consequence of the relativistic invariance of the theory. The connection between this dispersion difficulty and the other difficulties which arise in Dirac's theory is pointed out. G. C. McV.

2403. Continued Fractions Associated with Ellipsoidal Wave Functions. S. L. Malurkar. *Indian Journ. Phys.* 9. *pp.* 251–254, *March,* 1935.—Deductions are made, based on various values of the function U (ξ), in the equation previously reported [see Abstract 4873 (1934)]. N. M. B.

2404. Connection between Symmetrical and Linear Groups and the Problem of Many Bodies. P. Jordan. *Zeits. f. Physik,* 94. 7–8. *pp.* 531–535, *April* 8, 1935.—Develops a number of group theory relations which bear on the quantum electrodynamical problems of gauge invariance and the theory of holes. W. S. S.

2405. Equations of Motion in Non-Relativistic Quantum Mechanics. F. C. Powell. *Cambridge Phil. Soc., Proc.* 31. *pp.* 291–294, *April,* 1935.—The motion of a dynamical system can be pictured in two distinct ways: the Heisenberg picture and the Schrödinger picture, the equations of motion taking different forms in the two pictures, but having identical physical consequences. It is shown that the equations can be expressed in an invariant form, independent of the picture used, and that it is not even necessary to introduce a picture at all. It is also shown that there is no essential connection between the respective pictures and their representations. N. M. B.

2406. Self-Consistent Field, with Exchange, for Beryllium. D. R. Hartree and W. Hartree. *Roy. Soc., Proc.* 150*A. pp.* 9–33, *May* 1, 1935.—Fock's equations for the self-consistent field of an atom, including exchange effect, have been completely solved numerically for the normal state of neutral Be. The main features of the process of their solution are described and the results and energy values calculated from them discussed. In connection with the numerical calculations of energy values, which are difficult to check thoroughly, a new check, depending on the direct calculations of the difference of energy values calculated using the solution of Fock's equations and using any other wave functions, is developed and applied. The inclusion of the exchange terms has a small but appreciable effect on the (1*s*) wave function, which becomes more like that for the Be^{++} ion, and a considerable effect on the (2*s*) wave function, which contracts, and also becomes smaller near the origin compared to its maximum value. It is shown that these changes are qualitatively of a kind to bring calculated values of certain atomic properties into better accord with experiment, though no quantitative comparison can be made in this case. The calculated energy value is found to be brought into slightly better accord with observation, though the improvement is not great. H. H. Ho.

2407. Normal Helium Atom. J. H. Bartlett, Jr., J. J. Gibbons, Jr. and C. G. Dunn. *Phys. Rev.* 47. *pp.* 679–681, *May* 1, 1935.—A least-squares criterion for the goodness of approximate wave functions is proposed. The root-mean-square energy deviation for the six-term Hylleraas function is calculated to be 3·5 volts. It is shown that no ascending power series in the variables r_1, r_2 and r_{12} can be a formal solution of the Schrödinger equation. AUTHORS.

2408. Atomic Wave Functions for Excited States of Helium. W. S. Wilson and R. B. Lindsay. *Phys. Rev.* 47. *pp.* 681–686, *May* 1, 1935.—Normalised one-electron wave functions and the corresponding fields and energy parameters have been computed by the self-consistent field method for the following excited states of helium: $(1s)^2$, $(1s)(2s)$, $(1s)(2p)$, $(2s)^2$, $(2p)^2$ and $(2s)(2p)$. The results have been compared with those obtained by other methods and with experimental values. AUTHORS.

2409. Van der Waals Interaction of Hydrogen Atoms. L. Pauling and J. Y. Beach. *Phys. Rev.* 47. *pp.* 686–692, *May* 1, 1935.—The van der Waals interaction energy of two hydrogen atoms at large internuclear distances is discussed by the use of a linear variation function. By including in the variation function, in addition to the unperturbed wave function, 26 terms for the dipole-dipole interaction, 17 for the dipole-quadrupole interaction, and 26 for the quadrupole-quadrupole interaction, the interaction energy is evaluated as $W'' = -6{\cdot}49903\,e^2/a_0\rho^6 - 124{\cdot}399\,e^2/a_0\rho^8 - 1135{\cdot}21\,e^2/a_0\rho^{10} - \ldots$, in which $\rho = R/a_0$, with R the internuclear distance. Some properties of the functions $F_{\nu\lambda\mu}(\xi, \vartheta, \phi)$, which are orthogonal for the volume element $\xi d\xi \sin\theta d\theta d\phi$, are discussed, and their usefulness in atomic problems is pointed out. AUTHORS.

2410. Equation of a Wave in a Medium with Velocity a Function of Time. P. I. Wold. *Phys. Rev.* 47. *pp.* 735–738, *May* 15, 1935.—The equation of a wave in a medium for which the velocity is a function of time is obtained. On purely physical considerations for the case of $v = v_0e^{-at}$ and a simple periodic oscillation at the source, the equation is

$y = a \sin 2\pi\nu_0[t - (1/a) \ln (1 + (ax/c)e^{-at})]$. From other considerations the differential equation obtained is $\ddot{y} + a\dot{y} = c^2e^{-at}y''$ which is satisfied by the equation above. [See Abstract 1031 (1935).] AUTHOR.

2411. Can Quantum-Mechanical Description of Physical Reality be Considered Complete? A. Einstein, B. Podolsky and N. Rosen. *Phys. Rev.* 47. *pp.* 777–780, *May* 15, 1935.—In a complete theory there is an element corresponding to each element of reality. A sufficient condition for the reality of a physical quantity is the possibility of predicting it with certainty, without disturbing the system. In quantum mechanics in the case of two physical quantities described by non-commuting operators, the knowledge of one precludes the knowledge of the other. Then either (1) the description of reality given by the wave function in quantum mechanics is not complete, or (2) these two quantities cannot have simultaneous reality. Consideration of the problem of making predictions concerning a system on the basis of measurements made on another system that had previously interacted with it leads to the result that if (1) is false then (2) is also false. It must therefore be concluded that the description of reality as given by a wave function is not complete. AUTHORS.

2412. Creation and Annihilation in Statistical Assemblies. T. E. Sterne. *Cambridge Phil. Soc., Proc.* 31. *pp.* 303–306, *April*, 1935.—The statistical method described in 21·4 of Fowler's *Statistical Mechanics* was devised to deal with assemblies in which the total numbers of elementary physical systems remained constant. The same method is applicable, with no formal changes, to assemblies in which elementary physical systems of two different sorts can be created, and annihilated in pairs, like the negative and positive electrons in the theory of Dirac. AUTHOR.

See also Abstracts 2319, 2335, 2416, 2417, 2536, 2537, 2605, 2656.

RELATIVITY AND ETHER.

2413. Angular Momentum, Mass-Centre and the Inverse Square Law in Special Relativity. J. L. Synge. *Phys. Rev.* 47. *pp.* 760–767, *May* 15, 1935.—It is assumed that the interaction of two particles takes place by means of streams of elementary impulses travelling with the velocity of light c, an impulse of energy W having a momentum W/c. The momentum-energy 4-vector of a complete system and a skew-symmetric angular momentum tensor are defined in such a way that they are constants for the system, and the mass-centre of the system is defined in such a way that it travels with uniform velocity relative to a Galilean frame. The formulæ are similar to those of Newtonian mechanics. The two-body problem is discussed, and it is shown that for particles with constant proper masses and relative velocity small compared with c, the inverse square law is a consequence of the mechanical laws of conservation. The whole theory is relativistically invariant. AUTHOR.

2414. Einstein's Equations of Gravitation. J. Ghosh. *Zeits. f. Physik*, 94. 5–6. *pp.* 411–412, *April* 2, 1935.—It is pointed out that the solutions of Einstein's equations, $\mathrm{G}_{pq} - \frac{1}{2}\mathrm{G}g_{pq} = - 8\pi\mathrm{T}_{pq}$, for the case of spherical symmetry and for values of the energy tensor (T^p_q) such that $\mathrm{T}^p_p = 0$ and $\mathrm{T}^1_1 = \mathrm{T}^4_4$, always involve a constant of integration which is proportional to the cosmical constant. G. C. McV.

2415. Born's New Field Theory. T. Awano. *Phys. Math. Soc. Japan, Proc.* 17. *pp.* 127–136, *April*, 1935. *In English.*—Born's new unitary field theory [see Abstract 1875 (1934)] is discussed from the point of view of a new metric possessing real physical characteristics. J. S. G. T.

2416. Quantisation of the New Field Theory. Part II. M. Born and L. Infeld. *Roy. Soc., Proc.* 150*A. pp.* 141–166, *May* 1, 1935.—The commutation rules for the field components are given in a new form which makes no use of δ-functions. The behaviour of an electrodynamical system as a whole is described by a set of integral quantities: total energy, total momentum, centre of energy, total angular momentum. These quantities satisfy commutation rules which can be derived from those for the field components. The chief result is that the coordinates of the centre and the components of the total momentum are connected by the same commutation laws as in quantum mechanics, and that the components of the momentum commute; but the coordinates of the centre do not commute. All these results are connected with the Lorentz-invariance of the field equations. The laws of the motion of the centre can also be written as a Lorentz-invariant set of commutation relations. There is a close relation to Dirac's theory of the electron; for the even parts of the commuting coordinates used by Dirac do not commute, but satisfy together with the momenta and the total angular momenta the same commutation rules as the coordinates, momenta and angular momenta of the electromagnetic theory. The electromagnetic inner angular momentum plays an analogous rôle to that of Dirac's spin, but it has a real physical meaning and is not restricted to the eigenvalues $\pm \frac{1}{2}$. [For Part I see Abstract 121 (1935).] AUTHORS.

2417. Commuting Coordinates in the New Field Theory. M. H. L. Pryce. *Roy. Soc., Proc.* 150*A. pp.* 166–172, *May* 1, 1935.—Born and Infeld [see preceding Abstract] derive the coordinates of the energy centre and the inner angular momentum of a closed electrodynamical system, but these do not have simple commutation laws as in non-relativistic quantum mechanics. It is here shown that a coordinate vector and an inner angular momentum can be defined which do obey these simple commutation rules. They are rather artificial from a relativistic point of view; nevertheless, the absolute magnitude of the inner angular momentum vector is a relativistic invariant. AUTHOR.

See also Abstract 2397.

SOLUTION.

See Abstract 2382.

SURFACE TENSION AND COHESION.

2418. Surface Tension of Homologous Series. J. H. C. Merckel. *K. Akad. Amsterdam, Proc.* 38. 4. *pp.* 387–393, 1935.—It is shown that Szyskowski's formula connecting surface tension with concentration is unsound. The increase of surface tension with increase of concentration is, when the solution is dilute, directly proportional to the length of the carbon chain of the substance involved, and when the solution is more concentrated it is proportional to the square of the length of the carbon chain. P. H. B.

2419. Evaporation and Imbibition in Porous Bodies. Paulette Berthier. *Comptes Rendus*, 200. *pp.* 1105–1107, *March* 25, 1935.—In 1874 Decharme reported that a number of solutions soaked upwards into filter paper more quickly than water. Berthier reports that this anomalous behaviour is due to evaporation. In order to obtain comparable results it is necessary to work in a saturated atmosphere. P. H. B.

2420. Formation and Structure of Mono- or Bimolecular Layers of Fatty Substances on Metallic Surfaces. J. J. Trillat and H. Motz. *Comptes Rendus*, 200. *pp.* 1299–1301, *April* 8, 1935.—Mono- or bimolecular films of various long chain compounds (paraffins, fatty mono- or di-acids, alcohols, waxes, triglycerides, etc.) spread on gold films 50–80 $\mu\mu$ thick, were examined by the electron diffraction method. All save the di-acids, gave similar diagrams indicating that the long carbon chains were arranged zigzag, while the end group had practically no effect [see Abstract 2872 (1926)]. The dibasic fatty acids gave no electronic diagram, the length of their molecules lying flat on the surface. All metallic surfaces (*e.g.* of Ag, Au, Pt, Al) which when fresh gave pure diagrams of the metal, when reexamined after a few months, invariably indicated the presence thereon of a film of some long chain fatty compound. To avoid such contamination very special precautions are necessary. [See following Abstract.] C. A. S.

2421. Errors of Interpretation of Electronic Diagrams of Organic Substances. J. J. Trillat and H. Motz. *Comptes Rendus*, 200. *pp.* 1466–1468, *April* 24, 1935.—The dimensions of long-chained substances, *e.g.* cellulose derivatives, polyoxymethylene, especially those along the axis of a fibre, as deduced from electron diffraction diagrams, disagree with those deduced from X-ray diagrams, but are identical among themselves, and with those given by the films of fatty substances formed artificially or naturally on metallic surfaces or water [see preceding Abstract]. If, however, the film (*e.g.* cellulose) is washed with ether this pattern disappears and is replaced by what appears to be the true cellulose, etc., pattern. The origin of these films is probably accidental, and due to impurities in a solvent, touching with the fingers, etc., combined with the tendency of saturated hydrocarbons to spread on a smooth surface free from hydroxyl groups ; thus the presence of such a film is very marked on the tri-derivatives of cellulose, *e.g.* the triacetate, but completely or nearly absent from the di-derivatives, as the diacetate. C. A. S.

***2422. Theory of Electrocapillarity. Part III. S. R. Craxford, O. Gatty and J. S. L. Philpot.** *Phil. Mag.* 19. *pp.* 965–989, *May*, 1935. —A generalised apparatus for the thermodynamic consideration of electrocapillarity has been devised which involves only the use of externally observable work terms. By means of it a general electrocapillary equation has been derived which includes the Lippmann and Gibbs equations as special cases, and which is capable of being applied to any electrocapillary problem that is soluble by thermodynamic methods. [For Part II see Abstract 502 (1934).] AUTHOR.

***2423. Surface Potentials of Aqueous Solutions of Octyl Alcohol and Caprylic Acid. I. Sawai.** *Faraday Soc., Trans.* 31. *pp.* 765–768. *May*, 1935.—An apparatus for the measurement of the surface potential of solutions by the use of an air electrode coated with radioactive material is described. The surface potentials of caprylic acid and of octyl alcohol have been measured in dilute solution in various strengths of HCl and NaOH. AUTHOR.

See also Abstracts 2386, 2633, 2634.

VACUA, HIGH.

***2424. Vacuum Improvement of Oil Diffusion Pumps. W. Kerris.** *Zeits. f. techn. Physik*, 16. 4. *pp.* 120–122, 1935.—The employment of silica gel in oil diffusion pumps is found to produce an appreciable improvement of the vacuum, and is superior to active charcoal. The paper includes a full description of various types of pump, the mode of vacuum measurement, and relevant data with graphical illustration of results. H. H. Ho.

***2425. High-Speed Oil Diffusion Pump. H. W. Edwards.** *Rev. Sci. Instruments*, 6. *pp.* 145–148, *May*, 1935.—The peculiarities of design in this pump are, the use of streamlines in regions of high pressure and the introduction of small angle conical surfaces for baffles in the regions of lower pressures. The conical baffles are effective in preventing oil vapour from entering the chamber to be evacuated, and at the same time in offering a minimum of impedance to the flow of gas through the pump. A 3-in. pump with this design and operating on a Western mineral oil especially prepared for it has shown a pumping speed in excess of 50 l. per sec. at a pressure of $1\cdot0 \times 10^{-4}$ mm. AUTHOR.

***2426. Diffusion Pump. P. Jolibois.** *Comptes Rendus*, 200. *pp.* 1020–1022, *March* 18, 1935.—A Sprengel pump is slow in action during the later stages of exhaustion, although it has the useful property of allowing the gases pumped out of a system to be collected. The slowness of pumping may be overcome by connecting a simple glass diffusion pump between the Sprengel pump and the vessel to be evacuated. In the early stages the Sprengel pump works normally, and mercury is drawn up a barometer tube until it enters the boiler of the diffusion pump. At this stage the diffusion pump operates, and the Sprengel pump, which in effect backs the diffusion pump, has to work against only a moderate vacuum, so that a fairly fast pumping speed is still possible. G. E. B.

See also Abstract 2659.

VISCOSITY, FRICTION AND LUBRICATION.

2427. Theory of Structural Viscosity. Part I. W. Philippoff. *Kolloid Zeits.* 71. *pp.* 1–16, *April*, 1935.—In agreement with earlier authors, it is shown that structural viscosity is defined by three material constants, π_0, π_∞ and γ. For formulating the phenomenon the following expression has been chosen for the volume element: $\eta' = \eta_\infty + (\eta_0 - \eta_\infty)/(1 + p^2/\gamma^2)$, and applications are made to the capillary viscometer and the Couette-apparatus. A graphical process is described for the determination of the material constants. A large number of examples are given to illustrate the applicability to very different materials, and, based upon the data obtained, a provisional formulation of the dependence of particle size and concentration on the material constants is given. H. H. Ho.

2428. Comparison of Viscosity Data. F. T. Miles. *Am. Chem. Soc.*, J. 57. *pp.* 698–699, *April*, 1935.—In a recent paper Miss M. D. Waller has correlated the values of the ratio (r) of the viscosities, π_f and π_b, of a number of compounds at their respective melting and boiling points. Molecules of high symmetry have low values of r, and *vice versa*. It is now shown that correlation between r and molecular symmetry is due largely to dependence of the melting point on molecular symmetry, which does not involve considerations of viscosity. J. S. G. T.

2429. Friction and Lubrication. S. Erk. *Die Physik*, 3. 2. *pp.* 57–62, 1935.—Brief summaries are given of a number of recent papers on friction and lubrication. Amongst the subjects discussed are " dry " friction, *i.e.*, friction without lubrication, particularly for the case of plane surfaces, the effect of oxidation films on the surfaces, friction with partial and complete lubrication, and the properties of a number of common lubricants and of bearing metals. H. J. H. S.

***2430. Viscometer Consisting of a Sphere Rotating in a Fluid. A. Guillet.** *Comptes Rendus,* 200. *pp.* 1522–1524, *April* 29, 1935.—On replacing the coaxial cylinders [see Abstract 1443 (1935)] by concentric spheres of radii R_0, R_1, otherwise similarly arranged [*i.e.*, with the outer sphere fixed and the inner sphere attached by a wire to the vertical axis of a chronometric motor, A, rotating with velocity ω, the moment acting on the inner rotating sphere ($= C\,\alpha$, where C is a constant) being deduced from the angle, α, through which any point, B, thereon lags behind a point in the rotating portion of A in the vertical plane through B when at rest], and filling the space between the spheres with the liquid to be examined to a depth z, above the level of the common centre, if $z = R_1$, then the moment, M, is theoretically $= 8\,\pi\,\omega\,\eta\,R_1^3R_2^3/(R_1^3 - R_0^3)$. But comparison of the curve for η (viscosity) $= \phi$ (T) (T temperature), obtained with brass spheres with $R_0 = 3{\cdot}113$ cm. and $R_1 = 5{\cdot}82$ cm. (I) with the same curve obtained with the cylinder viscometer previously described, (II) shows that the value of η deduced from I must be divided by a constant factor (1·44) to agree with that from (II), which latter agrees with the results of Poiseuille's flow method. The curve $M = F\,(z)$ is regular. C. A. S.

***2431. Calibration of Capillary-Tube Viscometer. L. W. Spooner and P. Serex.** *Physics,* 6. *pp.* 162–164, *May,* 1935.—Because of deviations from a truly cylindrical surface at the capillary wall or to an abnormal orifice at one end of the capillary, the value of the coefficient, *m*, of the kinetic energy correction may be abnormally high with one direction of flow while it remains quite normal with the other direction. This variation may even cause the value of the principal instrumental constant, *C*, to be slightly greater in one direction of flow than in the opposite. This effect has been shown to be definitely greater than experimental error and is thought to be due to a slight difference in the "effective" capillary radius in the two directions of flow. This study shows the necessity of determining both *m* and *C* for each direction of flow through the capillary. This suggests the use of two viscosity formulæ: $\eta = C_l p_0 t - m_l C'\rho/t$ for "left-hand data," and $\eta = C_r p_0 t - m_r C'\rho/t$ for "right-hand data." Although a well-constructed viscometer may not require this unusual precaution, with it any commercially made capillary viscometer may be used with the highest possible accuracy. AUTHORS.

***2432. Apparatus for Measurement of Roughness. D. Clayton.** *Engineering,* 139. *pp.* 325–326, *March* 29, 1935.—Describes with illustrations an apparatus for the measurement of roughness such as of shafts undergoing comparative lubrication tests. It consists of a stylus carriage resting on two rods clamped to the surface under test and weighted to ensure steady contact with the guiding rods. A micrometer head clamped to these rods enables the carriage to be moved along by definite amounts. The rise and fall of the stylus in following the irregularities of the surface causes a suitably placed mirror to tilt about a hinge, the amount being measured by an auto-collimator. Readings being taken only every 0·0001 in. means that 30 to 40 min. are required for every 0·01 in. traverse; two tests in different parts over about twice this length are normally sufficient to ensure diagrams representative of the nature of the surface when attention is being paid to the minor irregularities. For finding the more gradual variations over a greater length a stylus with a small ball is used so that individual readings are not affected by the tiny local irregularities. C. O. B.

See also Abstracts **2376, 2383, 2399, 2632.**

ASTRONOMY AND ASTROPHYSICS.

ASTRONOMICAL APPARATUS AND OBSERVATORY EQUIPMENT.

***2433. Atmospheric Conditions at Radcliffe Observatory Site near Pretoria. W. H. Steavenson and H. Knox-Shaw.** *Roy. Astron. Soc., M.N.*95. *pp.* 447–450, *March*, 1935.—This site is on the range of hills south-east of Pretoria, 500 feet higher than the City and 4850 feet above sea-level. J. A. Anderson's method of testing the seeing [see following Abstract] was used, which involves the measurement of the "tremor disc." Tables are given of the seeing at Pretoria during February–June, 1930, comparing it with the mean of 6 years at Mt. Wilson; and of the relation (at Pretoria) between wind and seeing. The number of fine nights is adequate. The diurnal range of temperature is large, but may be neutralised by the use of suitable glass for the mirrors. A. S. D. M.

***2434. Astronomical Seeing. J. A. Anderson.** *J.O.S.A.* 25. *pp.* 152–155, *May*, 1935.—The problem of astronomical "seeing" consists of two parts: (*a*) determination of the form and movement of the wave surface (figure given) at any moment, and involving (1) the average distance between adjacent convex and concave portions; (2) the order of magnitude of radius of curvature; (3) rate of movement parallel to the earth's surface, etc., and (*b*) nature and location of the optical nonhomogeneities responsible for the above. Taking average seeing for a star not close to the horizon, a 4 in. telescope will show it moving irregularly so that its centre will remain within about 2″ diameter; a 60–100 in. telescope will at the same time give 2″ as the diameter (smallest photographic). It follows that no part of the wave surface makes an angle greater than 1″, and that adjacent convex and concave surfaces lie apart somewhere between 4″ and 60″. Corroboration is got from shadow bands during eclipses, from Exner's scintillometer and from a scintillation corrector of which a simple form is described. The author explains Montigny's principle, and Respighi's application of it to the spectrum of a star near the horizon at the 4 cardinal points, and the effect on such a spectrum with increasing altitude of the star. The study of such a spectrum gives information concerning the optical striæ which seem to contribute to bad seeing. [See preceding Abstract.] A. S. D. M.

***2435. Yerkes Auto-Collimating Spectrograph. G. W. Moffitt.** *J.O.S.A.* 25. *pp.* 142–151, *May*, 1935.—The instrument was built as an attachment to the Perkins 69-in. reflecting telescope. It is of the Littrow form, having an automatic lens of 24 in. focus, and is provided with a flat Michelson grating and also with a 33° flint glass prism. A thermostatic arrangement circulates air between two casings and allows of external air being used if desired to bring the instrument to the temperature of the surroundings before work is commenced. Several points susceptible of improvement are indicated. F. S.

***2436. Large Telescope Design. F. G. Pease.** *J.O.S.A.* 25. *pp.* 156–161, *May*, 1935.—The use to which a large telescope is to be put precedes the question regarding the type of design of the instrument itself. Point-source work, involving a very small field is important in a large observatory, and the author describes how the design of the 200-in. reflector of the Californian Institute of Technology is directed to this end:

especially in the optical part to light-gathering power, intensity and resolution in the constitution of the mirror, pyrex instead of solid glass and coated with Al vapour, because of the low temperature coefficient of pyrex, and high coefficient of reflection in the ultra-violet of Al. He discusses the grinding, polishing and testing of the mirrors; the three types of mounting (the fork, the counter-balanced, and the yoke); the driving apparatus; the tubes, spectroscopes and energy-measuring instruments; and lastly the alternative merits of double-walled domes, and such as are made of steel and covered with *papier maché* and insulated by corkboard under the outer metal covering, as well as insulation from ground rays.

A. S. D. M.

See also Abstract 2439.

COSMOGONY.

2437. Free Electrons in Astrophysics. H. Abraham. *Comptes Rendus*, 200. *pp*. 1290–1292, *April* 8, 1935.—It is suggested that, if the frequency of photons is reduced by collisions with free electrons in a manner similar to that found in the Compton effect, an explanation of certain astrophysical phenomena would be obtained. Thus coronal scattering would account for a displacement towards the red in the light from the sun and the B stars comparable with the Einstein effect and the K term in the radial velocity respectively. The velocity of recession of the spiral nebulæ could be accounted for if space were filled with an ionised cloud with density of order $1\cdot 5 \times 10^{-27}$ gm./c.c., the light from the nebulæ being reduced in frequency by collisions with the free electrons only.

G. C. McV.

DYNAMICAL PROBLEMS (ASTRONOMICAL).

2438. Fourier Series for Periodic Orbits around Triangular Libration Points. P. Pedersen. *Roy. Astron. Soc., M.N.* 95. *pp*. 482–495, *March*, 1935.—A continuation of an earlier paper [see Abstract 998 (1934)], taking as valid all values of the mass-product (both above and below 1/27) and carrying terms up to the 3rd order. The author finds as a necessary condition for periodic solutions, that $\omega^4 - \omega^2 + 27/16 - 27(1 - 2\mu)^2/16 = 0$, and this gives real values of ω except when $\mu(1 - \mu) > 1/27$, when no infinitesimal periodic orbit round L_4 will exist; and the papers deals only with such values of μ that satisfy $\mu(1-\mu) \leqq 1/27$. Diagrams are given, and these show that the period of the short-period orbits round the libration points L_4 and L_5 decreases as the orbit-size increases. He determines all critical values of ω_0^2, which are (1) = 0; (2) = 1; and (3) = $1\ (n^2 + 1)^{-1}$. He concludes that the critical long-period solutions have the property that the period is a multiple of the period in the corresponding non-critical short period solutions. A. S. D. M.

LATITUDE AND LONGITUDE.

***2439. Precision of the Prismatic Astrolabe in Latitude Determinations. A. Gougenheim.** *Comptes Rendus*, 200. *pp*. 1015–1017, *March* 18, 1935.—Forty-six series of observations on 60 stars made in Oct. and Nov. 1933, at San Diego (California), with a prismatic astrolabe, gave the latitude of the place ($34''\cdot 89$) to within an average error of $0''\cdot 15$ and a maximum error of $0''\cdot 2$. G. C. McV.

NEBULÆ.

See Abstract 2410.

PLANETS.

2440. Right Ascensions of Saturn in 1934. L. Gialanella. *Accad. Lincei, Atti,* 21. *pp.* 92–98, *Jan.* 20, 1935.—The paper gives tables of observations of right ascensions carried out on the planet Saturn during Sept.–Oct. 1934. A. J. McC.

2441. Difference Bands in Spectra of Major Planets. A. Adel and V. M. Slipher. *Phys. Rev.* 47. *pp.* 651–653, *May* 1, 1935.—This brief paper contains the first identifications of difference bands in planetary spectra. These absorption bands lie at 816$\mu\mu$, 802$\mu\mu$, 683$\mu\mu$, 673$\mu\mu$ and 584$\mu\mu$. They are due to methane gas and are found in the spectra of Jupiter, Saturn, Uranus and Neptune. AUTHORS.

2442. Elliptic Orbit of the Asteroid Maria Pia (1933 S.A.) L. Gialanella. *Accad. Lincei, Atti,* 21. *pp.* 157–160, *Feb.* 3, 1935.—This was discovered photographically by Delporte at Uccle Observatory, Belgium, on Sept. 16, 1933, and followed up during Oct. and Nov. The elements have now been worked out by the writer. M. A. E.

STARS.

2443. Relation between Mean Velocities of Stars. F. J. W. Whipple. *Roy. Astron. Soc., M.N.* 95. *pp.* 442–444, *March,* 1935.—A simpler proof of Smart's discussion of Edmondson's proposition that the ratio of the mean transverse velocity of the stars to the mean radial velocity is $\pi/2$. [See Abstract 1492 (1935).] A. S. D. M.

2444. Asymmetry of Stellar Motions and a Method for Determining the Apex of the Solar Motion. V. Nechville. *Comptes Rendus,* 200. *pp.* 1379–1381, *April* 15, 1935.—An expression is found for the number of stars, lying within a small range of position-angle, with proper motions greater than some positive limit. From this can be deduced the axes of the velocity ellipsoid and the vertex of the solar motion. The method also accounts for the observed variation in the numbers of stars flowing in stellar streams. G. C. McV.

2445. Continuous Spectra of Early-Type Stars. D. Barbier, D. Chalonge and E. Vassy. *J. de Physique et le Radium,* 6. *pp.* 137–146, *April,* 1935.—" Effective " temperatures of stars deduced by different observers show marked dispersion, and the authors have set themselves the task of selecting stars, fairly regularly distributed over the sky, determining the fundamental data for these, to use as scales for other stars in their near neighbourhood, thus minimising the atmospheric corrections. Early-type stars are indicated, because of the rarity of their spectral rays, for such standards, and the wave-lengths chosen are below 4500 Å, and in particular ultra-violet of such short wave-lengths as have not hitherto been studied. An astigmatic objective prism spectrograph is employed, and gives broadened spectra, easy to study in the microphotometer. These have been compared with an artificial star formed by a distant hydrogen tube, giving a continuous spectrum rich in the ultra-violet region. The 18 standard stars of types B, A and F, have been observed at the scientific station on the Jungfraujoch, and the sources of atmospheric absorption are discussed. The effective temperatures, and continuous absorption of the Balmer series are measured with precision, and the results compared with those of Yü and Karpov. A. S. D. M.

2446. Ionisation in Nebular Envelope Surrounding Star. V. A. Ambarzumian. *Roy. Astron. Soc., M.N.* 95. *pp.* 469–482, *March*, 1935.—The author explains the difference between the type of radiative equilibrium in planetaries [see Abstract 919 (1933)] and in the nebular envelope of relatively small radius surrounding emission line stars. This depends on the dilution factor W, which is of the order 10^{-13} at the surface of central planetary stars thus allowing the transitions from the second to higher levels to be neglected. But for Wolf-Rayet stars, W is of the order of unity, and, in addition, the cyclic transitions cannot be neglected, since it is they which are responsible for the emission lines. The difference, between the " direct " and the reverse cyclic processes, is very large, in the calculation of ionisation in the envelopes, and the author gives exact formulæ. He finds that the " classical " theory of monochromatic radiative equilibrium is a first approximation, but cannot explain the existence of emission lines ; the author's own theory forms a second approximation, but is of a general character. In making a geometrical model, he restricts himself to cases where W is small compared with unity ($W < 1/100$), and makes use of Milne's work [see Abstract 398 (1931)]. In finding the ionisation in the envelope, he takes the interesting case where it is not transparent to radiation of the frequency ν_{13}, that is, the optical thickness is large as compared with unity, and in such a case, the ionisation decreases very slowly in the outward direction. A. S. D. M.

2447. Internal Constitution of Perfect Gas Stars. Part II. P. ten Bruggencate. *Zeits. f. Astrophysik*, 10. *pp.* 28–35, *March* 13, 1935.—The structure of perfect-gas stellar models is discussed when singularities are allowed on the surface, but not at the centre of a model. Three types of solution of the equations of the problem exist and are compared with the three types of solution of Milne's theory in which models with central singularities, but no surface singularities, are considered. The three types of solution are uniquely characterised by the magnitude of the energy-generation. All calculations are carried out for the standard model. [See Abstract 162 (1935).] G. C. McV.

2448. Photometric and Spectroscopic Study of Three Variable Stars. P. Guthnick. *Preuss. Akad. Wiss. Berlin, Ber.* 30. *pp.* 506–528, 1934.—In continuation of former work on three stars, the following results are announced. (1) Bailey 95, in the globular cluster M3, is either an irregular red variable or one of the type R Coronæ : its spectrum is of late type, sometimes showing bright H lines, and the photographic magnitude varies between 13·2 and 14·7, with intervals of constant light which last for a month or more. (2) ε Ursae Majoris shows periodical changes in the intensity of the K line, and these have been again followed during the years 1931–1934 and compared with Miss Cannon's estimates in 1887, 1888, and 1894 : they agree well and give a period of 5*d*·0887. (3) QS Aquilæ is a remarkable spectroscopic double and eclipsing variable. The period has now been determined, in satisfactory agreement with results found at the Victoria Observatory, as 2*d*·5133. M. A. E.

2449. Statistical Aspects of the Study of Variable Stars. E. Öpik. *Harvard Coll. Obs., Circ. No.* 393. [12 *pp.*], 1934.—The data needed for an efficient study of variable stars are considered and summarised. The observed frequency of magnitudes may in practice serve to determine the shape of a light-curve, since the closely correlated characteristics of variables usually indicate which one of the typical curves is most probable in any given case. It is shown how the period may be derived from an approximate light-curve and range, how spurious variables may be eliminated, and how to obtain the maximum fraction of true discoveries from comparing pairs of plates. M. A. E.

2450. Variable Stars in High Galactic Latitudes. H. Shapley and Emily M. Hughes. *Harvard Coll. Obs., Ann.* 90. 4. *pp.* 163–175, 1935.—Variables in galactic latitudes higher than ± 30° contribute best to a knowledge of their distance as light absorption is not sufficient there to prevent the use of Cepheids for photometric measurement of distance. The absolute median magnitude of cluster type Cepheids is very close to zero. The present paper inaugurates a programme for covering completely the high galactic latitude skies. The new fields are examined and a list of the data and notes for about 300 variables is given. It is noteworthy that there is almost a complete absence of classical Cepheids. Amongst the variables there is a Nova which appears to be a member of the small Magellanic cloud. A. S. D. M.

2451. New Variable Stars in Low Galactic Latitudes. H. Shapley and Henrietta H. Swope. *Harvard Coll. Obs., Ann.* 90. 5. *pp.* 177–188, 1935.—The paper deals with 3 additional low latitude fields but only one (MWF 168) has been thoroughly studied. A table of 94 new variables is given, as also a second table containing 152 long period variables in MWF 184. In the first table, eclipsing stars are more than usually numerous as compared with cluster type variables, and classical cepheids are relatively numerous also. In MWF, long period variables have a small maximum frequency period (less than 200 days), but this may be accounted for by the faintness of the stars. MWF 193 is centred in Sagittarius, one of the richest regions in the sky, and it is estimated that here, there are about 10 variables to a square degree. A. S. D. M.

2452. Light Curve of SS Cygni. T. E. Sterne and L. Campbell. *Harvard Coll. Obs., Ann.*, 90. 6. *pp.* 189–206, 1935.—This star's vagaries are connected with time and extent of sudden outburst to maximum. A statistical investigation of the light curve's properties and of six quantities such as " steepness " of rise to maximum, etc. A figure gives the observed frequencies and Karl Pearson's method of comparing such with those expected on any hypothesis is adapted to the present problem. SS Cygni's cycles are in excellent agreement with a normal error curve of mean $50^{d} \cdot 48$ and standard deviation $15^{d} \cdot 00$. Whittaker and Gibbs are shown to be wrong in their conclusion that a periodogram analysis gives periodic terms for SS Cygni's period. A list is given of 14 different associations which seem real. Association and correlation tables are given. A. S. D. M.

2453. Variable Stars of Short Period. S. Gaposchkin. *Harvard Coll. Obs., Bull.* 898. *pp.* 9–19, *March* 1, 1935.—The author describes a new automatic device for successive exposures on one plate by three instruments sensitive to red, yellow and blue. He takes (1) cluster type variable AR Herculis with possible period changes not yet determinable [see Abstract 4920 (1934)]. The blue and red light curves agree well, but the red range is smaller showing the star's surface brightness smallest at minimum. (2) Cluster type variable B.D. $+ 0^{\circ} \cdot 4900$, the shortest period known and determined as $87^{m}\ 53^{s} \cdot 8$, and is probably constant. (3) Eclipsing star WX Cephei is found to have greater period than Schneller's ($3^{d} \cdot 3777$). The two have the same surface brightness and class A0, but unlike others of its nature give the same minimum epoch from the *phg* and *phv* curves. The eclipse is partial (improbably annular) and *i* is near 80°. (4) Cluster type variable RZ Cephei having the largest translational (1200 km./sec.) velocity known ; Miss Leavitt's and Florja's change of period not confirmed. Spectral class B8 to A0 and spectrum varies from A0 to A3. A. S. D. M.

2454. Light Curve of Nova Herculis, 180445. L. Campbell. *Harvard Coll. Obs., Bull.* 898. *pp.* 20–25, *March* 1, 1935.—A provisional light curve based on 2017 observations by 170 different observers, and tables of the (1) bright comparison stars, (2) means of visual observations, and (3) observed dates of maxima and minima are given. The average period between maxima and between minima are $4^d\cdot 1$ and $4^d\cdot 4$; the mean magnitudes of the maxima and minima are $2^m\cdot 2$ and $3^m\cdot 0$. The principal maximum was on Dec. 22 (J.D. 2427794) (magnitude 1·4). In general this Nova resembles most nearly that in Auriga of 1891. A. S. D. M.

2455. Oxygen and Carbon in Nova Herculis, 1934. F. J. M. Stratton and A. Beer. *Roy. Astron. Soc., M.N.*95. *pp.* 432–436, *March*, 1935.—Three forbidden lines (*O*I) were present as bright bands at the measured wave-lengths on 1935 Feb. 17·25, of 6300·06, 6363·86 and 5578·38 (green auroral line) ; a plate of the spectrum is given. There is also given a table of neutral oxygen lines, which belong to the triplet and quintet systems, and another of the lines of neutral carbon. The forbidden lines of OI (which are the exact analogues of the lines of [OIII] in nebulæ and Novæ, have no absorption lines on the violet side ; two bright maxima, almost equally displaced to red and violet, may indicate motion in line of sight of ± 280 km./sec. The bright band contours cannot be explained by the hypothesis of expanding shells alone, but may be due to streams or jets of equal velocities in opposite directions. The case of a Nova seems, for the transitions from the metastable level $^1D_2$, to be intermediate between the aurora and night sky light, and the light from nebulæ [see Abstract 2481 (1930)]. A. S. D. M.

2456. Nova Herculis. P. Guthnick. *Naturwiss.* 23. *pp.* 249–253, *April* 19, 1935.—A comprehensive report of the observed characteristics of Nova Herculis from its discovery by Prentice on December 12th, 1934, up to the present time. The observations are recorded under the following headings : brightness and colour index ; position, identity with a previously observed faint star, distance and absolute brightness ; spectrum. In conclusion some speculations are given as to the probable future career of the Nova. J. E. K.

2457. Be Spectrum Variables. B. P. Gerasimovič. *Observatory*, 58. *pp.* 115–124, *April*, 1935.—The peculiar variations may be due to change in total intensity, or in V/R, or by cyclic processes in the upper reversing layers and chromosphere, and in turn to variations in the lower atmosphere. Intensity changes in emission lines are unrelated to other stellar characteristics. Balmer lines indicate by their width rapid motion, radial expansion and contraction [see Abstract 3596 (1934)] and may be cyclical. There are not, as in novæ [see Abstract 4915 (1934)] expanding, transparent envelopes of non-uniform velocity, since Be stars there is central depression in Balmer lines, due, perhaps, to self-absorption in an envelope expanding with decreasing velocity, so that the self-absorbing outer layers move with small velocities. The V/R cyclic variation [see Abstract 1794 (1933)] is summarised and a schematic expanding chromosphere originating in a cyclic process due (say) to ejection which ceases, or a collapse of low chromospheric strata, and the envelope continues its motion as a detached shell. A. S. D. M.

2458. Spectrum of R Aquarii, 1919–1934. P. W. Merrill. *Mt. Wilson Observat., Contrib. No.* 513. *Astrophys. J.* 81. *pp.* 312–333, *May,* 1935.—This variable star, of period 387 days, was discovered by Harding in 1811. The character and cyclic changes of its spectrum (type M7e) resemble those of normal long-period red variables. In addition, however, bright lines characteristic of gaseous nebulæ were conspicuous in 1919 to 1925, remaining nearly constant in intensity, and showing remarkable irregularities in their displacements. Since then they have become much fainter. In 1922 a third spectrum appeared, and has at times been dominant. At first it resembled that of the nucleus of a planetary nebula (type O), but later changed to B type, suggesting the presence of a blue companion star similar to the companion of Mira. This composite spectrum is fully described and discussed, and compared with phases of other variables. Further study, including observation of the lenticular nebulosity surrounding the star, may throw light on the whole problem of Mira-variables. M. A. E.

See also Abstract 2437.

SUN.

2459. Brightness of Prominences as Shown by Spectrohelioscope. G. E. Hale. *Roy. Astron. Soc., M.N.*95. *pp.* 467–468, *March,* 1935.—A list is given of 8 factors on which the apparent brightness of a prominence may depend. With a given grating and magnifying power, the best way to increase the apparent brightness of the monochromatic solar image is to decrease the breadth of the field of view. The author retains a single pair of oscillating slits on his own instrument, so as to be able very quickly to change the amplitude. He calls attention to the " rapidly changing comet-like flocculi " which may form in a few seconds and pursue curved paths at changing speeds until their black heads impinge on the outer boundary of the prominence. A. S. D. M.

2460. Change of the Intensity of Radiation from Sunspots over the Sun's Disc. A. J. M. Wanders. *Zeits. f. Astrophysik,* 10. *pp.* 15–27, *March* 13, 1935.—The ratio of the radiation-intensity from the sunspot and from the surrounding part of the photosphere was compared for various positions of the spot on the sun's disc. The change in the ratio was completely accounted for by the change in perspective. It was concluded that the character of the radiation from a sunspot was the same throughout the optically accessible region of the spot. G. C. McV.

2461. Absorption of Sunlight by the Earth's Atmosphere in the Remote Infra-Red. A. Adel, V. M. Slipher and E. F. Barker. *Phys. Rev.* 47. *pp.* 580–584, *April* 15, 1935.—Spectroheliometric observations on the absorption spectrum of the earth's atmosphere have been extended from 5μ to 21μ. The long-wave limit of transmission imposed by the atmosphere occurs at $13 \cdot 5\mu$. It is occasioned primarily by ν_2 of CO_2 and to a lesser extent by ν_2 of O_3. The CO_2 absorption blends with the pure rotation spectrum of water vapour at approximately 17μ to render the region beyond $13 \cdot 5\mu$ opaque to stellar radiation. AUTHORS.

See also Abstracts 2444, 2476, 2491.

GEOPHYSICS.

GEOPHYSICS, APPLIED.

***2462. Experimental Interpretation of Magnetic and Gravimetric Anomalies. W. P. Jenny.** *Terr. Mag.* 40. *pp.* 71–78, *March*, 1935.—A method and apparatus are described, which allow experimental interpretations of magnetic and gravimetric anomalies. The basic difference between this and other methods so far applied lies in the use of the direction in space of the magnetic lines of force as due to local structures, instead of the magnetic intensity, for interpretative purposes. This method gives due consideration to the inhomogeneous magnetisation of structure and to the relation between the magnetisation of a geologic structure and its direction of strike and geographical position. Based upon the relationship between magnetic forces and the second derivatives of the gravitational potential as given by Eötvös, the direction of the magnetic lines of force as due to local structures may be calculated from the data obtained with torsion-balances. This procedure makes it possible also to interpret gravimetric anomalies by the experimental method under discussion. As an example for the practical application of this method the large magnetic anomaly at Grand Rapids, Michigan, has been interpreted in terms of structure.

AUTHOR.

HYDROSPHERE, PHYSICS OF THE.

2463. Coastal Currents. W. Werenskiold. *Geofysiske Publ.* 10. *No.* 13, [14 *pp.*], 1935. *In English.*—Reference is made to Mohn's equation for the velocity of water currents having an unequal distribution of density and to the improvement of the theory by V. Bjerknes. The latter involves cumbersome computations of density or specific volume from the temperature, salinity, and depth and then a series of summations to obtain the pressure distribution and slope of the isobaric surfaces. With the help of a series of lines of equal density (isopycnics) or equal specific volume (isosteres) the velocity of flow can be found from the slope of the curves. Values for the velocity are set out in terms of isopycnics and isosteres and examples are considered for two areas of the Norwegian Sea. The water transport is then obtained from the velocity by a simplified method for a straight or curved boundary and it is shown that it can be calculated from density determinations at only one station near the shore. This theory is tested and confirmed by concrete examples for four oceanographic sections given by Helland-Hansen and Nansen at 63° N and 67° N, west of Stad and Lofoten. Similarly the transport through the point of a section outside any vertical line and the transport between any two vertical lines can be obtained, from the observations, at only one station. Reference is made finally to Ekman's results.

R. S. R.

2464. Oscillations of Water in Canals of Asymmetric Plan. K. Hidaka. *Imp. Marine Obs., Kobe, Japan, Mem.* 5. *pp.* 267–326, *March*, 1935. *In English.*—The author treats the free oscillations of water in canals whose width varies according to the law, $w = 2b\left(1-\frac{x}{a}\right)^p\left(1+\frac{x}{a}\right)^q, p>q \geqq 0$; or $w = 2b\left(1-\sin\frac{\pi x}{2a}\right)^{\frac{p'}{2}}\left(1+\sin\frac{\pi x}{2a}\right)^{\frac{q'}{2}}$, $p' > q' \geqq 0$; when their depth follows one of the four laws: h = const.,

$h = h_0\left(1-\frac{x^2}{a^2}\right)$, $h = h_0\left(1-\frac{x}{a}\right)$ and $h = h_0\left(1+\frac{x}{a}\right)$. The case $p = q = m$ or $p' = q' = m'$ reduces to the problems treated in the earlier paper [see Abstract 3294 (1931)]. Numerical solutions are specially worked out when $p = 1$ and $q = \frac{1}{2}$ for each of above four laws of depth. AUTHOR.

2465. Helium-Neon Content of Ocean Waters. W. D. Urry. *Am. Chem. Soc., J.* 57. *pp.* 657–659, *April*, 1935.—The variation of the helium-neon content of ocean waters has been measured. It is shown how such data may be used in fixing a base line for the oxygen content, and by comparison with the measured oxygen and recorded temperatures, how this base line may be used in tracing the history of the present oxygen or the water masses involved. [See Abstract 4343 (1933).] AUTHOR.

LAND, PHYSICS OF THE.

2466. Elastic Constants of the Earth. A. Prey. *Gerlands Beitr. z. Geophys.* 44. 1. *pp.* 59–80, 1935.—On assumptions previously made [see Abstract 1361 (1930)] the variation of the rigidity of the earth with the distance (r) from its centre is computed. The result is: $n = r^2(1-0\cdot97r^2)\cdot 10^{13}$ C.G.S. units. W. A. R.

2467. Quicksand as a Thixotropic System. H. Freundlich and F. Juliusburger. *Faraday Soc., Trans.* 31. *pp.* 769–774, *May*, 1935.—A sample of quicksand from Knott End, Fleetwood, was distinctly thixotropic, in contrast to an ordinary sand taken from the neighbourhood. The thixotropy of the quicksand is ascribed to the presence of 2·1 per cent of a fine plastic clay, the ordinary sand containing only 0·3 per cent. When the clay—together with all particles having a diameter below 10μ—was separated from the coarser grains, the residue was no longer thixotropic. On re-mixing the clay with the residue, thixotropic behaviour reappeared. An important further feature is that the particles of the quicksand were more homogeneous and smaller than those of the ordinary sand. The correlation between thixotropy and loose packing (the latter being indicated by a large sedimentation volume) was always found to hold. All the non-thixotropic sands had a smaller volume of sedimentation, which was practically identical with that of a closely packed fine quartz powder in pure water. AUTHORS.

METEOROLOGY.

***2468. Meteorological Radio Soundings. R. Bureau.** *Onde Élec.* 14. *pp.* 10–26, *Jan., and pp.* 87–96, *Feb.*, 1935.—The author provides first a historical survey of methods used and shows the advantages possessed by the radio sounding balloon over other methods on account of (1) its use in all kinds of weather, (2) the larger heights attained, (3) the results becoming available during the ascent, and (4) its use in sparsely populated areas. The requirements of the problem and the main difficulties are outlined. Details are given of various systems used at present employing electrical, mechanical or a joint method and in which the form, phase or frequency change is used in transmitting the signal. The apparatus used at Trappes is described in detail for the meteorological and electrical elements and the method of calibration prior to release. Finally, some results of soundings are given. R. S. R.

2469. Horizontal Temperature Differences over Small Distances. E. G. Bilham. *Roy. Meteorolog. Soc., J.* 61. *pp.* 159–164; *Disc.*, 164–166, *April*, 1935.—Assuming a probable lag-coefficient for the thermometer used by Best [see Abstract 2602 (1931)] and a simple harmonic oscillation of temperature of suitable period it is shown mathematically that the true amplitude of the temperature oscillations recorded by him during normal lapse (10–17 hr.) must have been of the order of 4–5° F. ; and that the decrease therein observed with increase of wind may not have been real. As a result of the *Discussion* it was shown that on the assumption of instantaneous changes of temperature at intervals of, *e.g.* 30 sec., the response of the thermometer would be substantially greater than for equivalent sinusoidal variations, and the true amplitude of the oscillations substantially less than as deduced above, assuming the recorded amounts to have been the same. C. A. S.

2470. Origin of Local Heat Thunderstorms. H. v. Ficker. *Preuss. Akad. Wiss. Berlin, Ber.* 29. *pp.* 478–503, 1934.—Reference is made to earlier conclusions on the formation of thunderstorms [see Abstract 533 (1933)] in which heating at the surface or cooling at higher levels supplied the cause. Two series of days with thunderstorms are considered here in which following warm cloudless days with no thunder there were subsequent developments of thunderstorms with only small diurnal temperature changes and no cooling in the upper levels. The change was traced to the advection of damper air into the middle layers and a resulting change from stable to the unstable labile state. The conclusions are obtained by a detailed comparison of temperature and humidity, and derived values of potential temperature on successive days, above Lindenberg in one case, and above Munich in the other. Subsequent to the inflow of damper air only small amounts of surface heating were necessary to produce instability. R. S. R.

2471. General Circulation of the Atmosphere and its Seasonal Variations. H. Arakawa. *Geophys. Mag., Tokyo,* 8. *pp.* 219–294, *March,* 1935. *In English.*—This paper is mainly a mathematical treatment of the subject. After stating in the introduction the reason for the atmospheric circulation, a general solution corresponding to any distribution of temperature of the atmosphere is first dealt with. Thereafter a detailed solution is given of the relation $T_1 = (Ar^n + B/r^{n+1})\, P_n\,(\cos\theta)$, T_1 being the excess of temperature above the equilibrium temperature. Three cases are considered, $n = 1$, 2 and n. Application of the solutions is made to the distribution and variation of air temperatures, to the migration of the wind systems over the globe and to the migration of the pressure belts with the sun. Tables show that calculated values of temperature agree well with actually observed values and diagrams illustrate the calculated velocities and variations of velocities in the air currents at various seasons. The author then proceeds to discuss the oceanic circulation and points out that the equations used in the solution of the atmospheric circulation can be applied here. A solution of the motion can thus be found, which is modified, however, by various effects, *e.g.* by the distribution of land and water, by winds, etc. It is also shown that the equations may be applied to the motion of the air within the stratosphere. A. E. M. G.

2472. Fronts and Occlusions. E. Gold. *Roy. Meteorolog. Soc., J.* 61. *pp.* 107–157, *April,* 1935.—After referring in the first section to early ideas regarding fronts between cold and warm masses of air, the author in his next section outlines the development of the investigation of such fronts by the Norwegian school of meteorologists. The theory underlying the processes comes then under review and examples are considered. When the general theory of fronts had been established attention was directed to an examination of air masses and so the author devotes his next section to such an examination, in particular dealing with results of observations in the upper air in tropical air at Duxford at the beginning of this year. Fronto-lysis, the change from a surface of zero order to a surface of the first order, and its opposite Fronto-genesis, together with examples on the same are then passed under review. A large number of diagrams illustrate the examples discussed. The author now proceeds to discuss the isothermal layers observed and deals in particular with two special cases (1) when the layer ascends or descends without lateral expansion or contraction, (2) when the atmosphere has a uniform lapse rate a, the sinking of the layers necessary to turn the whole atmosphere into an isothermal state. The concluding section deals with the causes for the main events occurring in the troposphere, and the origin of these is considered to be in the troposphere itself. A. E. M. G.

2473. Lunar Atmospheric Tide at Honolulu, 1905-1924. S. Chapman. *Roy. Meteorolog. Soc., J.* 61. *pp.* 189–194, *April,* 1935.—The lunar atmospheric tide is determined from 20 years' hourly barometric values at Honolulu. The annual mean result is 45 sin $(2t + 66°)$ microbars, so that high atmospheric tide occurs about 46 minutes of mean solar time after the moon transits. The amplitude of the tide is in fair accordance with that found at other stations in about the same latitude. The tide is distinctly later in the four months Nov. to Feb. than at other times of the year. The probable error of the mean result is small, about 2·6 microbars. The harmonic coefficients for the first four components of the solar diurnal variation are also given. [See Abstract 1043 (1934).] AUTHOR.

2474. Advection Mechanism of Atmospheric Pressure Oscillations. H. Ertel and Sjan-zsi Li. *Zeits. f. Physik,* 94. 9–10. *pp.* 662–673, *April* 16, 1935.—Attention is drawn to an error in Rossby's general theory of advection which affects the application of this theory to the phenomena of the stratosphere, and a new theory is developed in which this error is avoided. Applications of the new theory confirm v. Fickers' views on the atmospheric advection mechanism. J. J. S.

2475. Condensation-Nuclei in the Atmosphere. H. Landsberg. *Monthly Weather Rev.* 62. *pp.* 442–445, *Dec.,* 1934.—The results of 1,051 observations of condensation-nuclei at four different locations are given. Connections between the number of nuclei and convection and turbulence are shown; and correlations between nuclear counts, relative humidity, visibility and wind are mentioned. The relationship between nuclei contents and air mass is discussed, and the former found to be a valuable help in air mass analysis. The effects of nuclei on human health, and their adsorption of radioactive emanation, principally with the occurrence of surfaces of subsidence, are discussed. AUTHOR.

2476. Infra-Red Transmission of Radiation by Water-Vapour. F. E. Fowle. *Am. Illum. Eng. Soc., Trans.* 30. *pp.* 273–278; *Disc.,* 279–280, *March,* 1935.—After briefly discussing the methods by which the amount of atmospheric water-vapour can be measured in terms of cm. of precipitable water, the measurement of the losses suffered by the solar radiation in passing through the water-vapour are then considered. Finally, scattering losses due to air and water-vapour molecules, and dry and wet dust, as well as the transparency of steam to radiations from 7 to 20 μ are very briefly dealt with. R. C. F.

2477. Atmospheric Visibility and its Measurement. K. Kähler. *Naturwiss.* 23. *pp.* 253–256, *April* 19, 1935.—Comprises a survey of our present knowledge of the factors influencing atmospheric visibility and of methods by which visibility may be measured. The following sub-headings indicate the scope of the report: Visibility estimates; theory of horizontal visibility, (*a*) visibility of black objects, (*b*) visibility of white objects, (*c*) visibility of arbitrary objects; Measurement of visibility, (*a*) artificial darkening, (*b*) photometric measurement, (*c*) photoelectric measurement. J. E. K.

2478. Attenuation of Light in the Lower Atmosphere. E. O. Hulburt. *J.O.S.A.* 25. *pp.* 125–130, *May*, 1935.—Researches on the attenuation of light in the lower atmosphere permit the conclusions: (*a*) From 3500 to 5400 Å in distances up to 6 km. the attenuation of pure air and water vapour is due to molecular scattering with negligible true absorption; (*b*) from 3000 to 2000 Å pure air possesses an absorption in addition to molecular scattering, probably due to oxygen, which increases rapidly with decreasing wave-length; (*c*) the degradation of visible light in normally clear air at sea, probably due to prevalent haze, is such as to reduce light to 1/10 in 10 nautical miles; (*d*) natural fog degrades visible light either equally across the spectrum or slightly less for red than for blue light but not enough to redden appreciably white or yellow lights. Infra-red photographs to distances of 8 nautical miles through haze and fog showed objects at 0·5, 1·2, 4 and 8 miles when the haze and fog were such that objects could just be seen at 0·5, 1, 3 and 6 miles. AUTHOR.

2479. Visibility by Day and Night. M. G. Bennett. *Roy. Meteorolog. Soc., J.* 61. *pp.* 179–186, *April*, 1935.—Experiments carried out at Kew and Farnborough to test the theories of visibility put forward by Koschmieder and the author, and to determine the relation between visibility by day and night. [See Abstract 4830 (1932).] AUTHOR.

2480. Lines or Bands in Spectrum of Night Sky. J. V. Karandikar. *Indian Journ. Phys.* 9. *pp.* 245–250, *March*, 1935.—A continuation of Ramanathan's work [see Abstract 1811 (1933)]. An additional spectrograph (single prism) with a camera lens having longer focal length and smaller aperture ratio than the first instrument, was also used, and with it were obtained plates of 75 and of 181 hrs. A table gives the wave-lengths and estimated relative intensities of the lines together with a comparison of those obtained by Dufay and Cabannes. These show good agreement, but the green auroral line (5577 Å) is the only one identified. A. S. D. M.

2481. Spectra of Night Sky and Aurora in the Long-Wave Region. L. Vegard and E. Tønsberg. *Zeits. f. Physik*, 94. 7–8. *pp.* 413–433, *April* 8, 1935.—Comparable spectra of the light of the night sky and the aurora are photographed at Oslo [see Abstract 2809 (1934)] and Tromsö. As compared with the green line, the red bands are much more intense in the night sky spectrum than in the auroral spectrum and their positions are different. The intensity effect is greater at Oslo than at Tromsö. The red bands of the night-sky spectrum coincide with those bands of the first positive group which occur in the afterglow of N. The band $n' = 9 \rightarrow n'' = 5$ and the sequence $n' - n'' = 2$ appear strongly. The second positive and first negative groups do not seem to be present in the typical night-sky spectrum. This is in accordance with Vegard's theory. The red line OI 6300 occurs with varying intensity in the night-sky spectrum, as in the auroral spectrum. The large numbers of lines reported by Sommer [see Abstract 4982 (1932)] and by Cabannes [see Abstract 1066 (1935)] cannot be confirmed. L. A. W.

2482. Vegard-Kaplan Bands in Night-Sky Spectrum. J. Cabannes and J. Dufay. *Comptes Rendus*, 200. *pp.* 1504–1506, *April* 29, 1935.—The authors observed this complicated emission spectrum [see Abstract 1527 (1934)] during 1933 Aug. to 1935 Feb. ; the most intense and characteristic features being those discovered by Rayleigh at 4435 and 4220 Å, and by Kaplan attributed to molecule-nitrogen found in the laboratory by himself and Vegard. A diagram and table indicate that the 6 bands of Vegard-Kaplan can be recognised in the most intense sky radiation. The A → X bands can also be recognised in the polar aurora ; the bands of the 2nd positive system of N^2 and those of the negative system of N^2_+ are intense and mask certain of these bands. The presence of the first positive system of Nitrogen bands [see Abstracts 198 and 1066 (1935)] shows that a great number of N molecules in the upper atmosphere are in the metastable state A. The mean life of such metastable molecules is long, but with the rarity of molecular collisions in the upper air, spontaneous returns to normal state of the forbidden lines A → X become possible. An analogous phenomenon has been found by Bowen for nebulæ and by McLennan for the aurora and night-sky in the forbidden lines 5577 and 6303 Å, of atomic oxygen. A. S. D. M.

***2483. Psychrometric Charts for High and Low Pressures. D. B. Brooks.** *Bureau of Standards, Publ. M.* 146 [8 *pp.*], *Jan.* 18, 1935. —Psychrometric charts are reproduced for the determination of humidity from wet and dry bulb temperatures obtained at pressures ranging from 1/8 to 10 atmospheres. Separate charts are drawn for Fahrenheit and centigrade temperatures ; those in the former case are based on Ferrel's formula, but the centigrade charts are based on the formula, $e = e' - 0{\cdot}000652\ P\ (t-t')\ (1+0{\cdot}00102\ t')$ which is of the same type but has been slightly modified in the light of recent work. The methods of using the charts are illustrated by examples. R. W. P.

***2484. Lambrecht-Wenk Hydrograph. L. Kassner.** *Zeits. f. Instrumentenk*, 55. *pp.* 169–173, *April*, 1935.—Sources of error which may arise in the use of this instrument [see Abstract 1051 (1934)] are described. The temperature and humidity elements are directly connected and their respective errors are additive while their different rates of response may give quite incorrect results for specific humidity if changes occur quickly as during aircraft ascents. In technology where more or less constant vapour pressure is observed the apparatus is suitable but not so for quick or considerable changes in amount. The equation used for relative humidity holds over the range 10° C. to 30° C. and above 25 % relative humidity. In ordinary practice this suffices but in regions with föhn winds or low temperatures or in aircraft ascents the more complicated form of apparatus is essential to avoid large errors. R. S. R.

***2485. Cup Anemometer. W. Grundmann.** *Zeits. f. Instrumentenk*, 55. *pp.* 208–212, *May*, 1935.—An equation is obtained for the rotational force of the wind in terms of the radii of arms and cups, air density and shape, velocity and rotation of the cups. Apart from friction the rate of rotation of the cups depends on the velocity of the air and not on its density. On account of friction the ratio of the forces on the convex and concave sides of the cups varies within wide limits. Temperature changes are of importance for with lower temperatures and contraction of the arms and cups there is increased friction due to contraction towards the spindle and greater viscosity of the lubricating oil. Velocities in cold seasons and at high levels are thus too low. Errors arise also in that the instrument has not a constant factor connecting air speed and rotation rate of the cups. Errors up to 50 % may occur if the arms or cups become coated with ice or snow. Instruments with least weight and least moment of inertia are shown to respond more quickly to wind changes. R. S. R.

See also Abstracts **2393, 2433, 2434, 2461, 2499, 2518.**

SEISMOLOGY.

2486. Amplitude of P and S Waves of Deep Earthquakes. H. Honda. *Geophys. Mag. Tokyo*, 8. *pp.* 327–332, *March*, 1935. *In English.*—The amplitudes and directions of motion at the earth's surface of the P and S waves due to the earthquake of 5 May, 1932, at Osaka Bay, at 25 stations have been calculated in the same way as before [see Abstract 657 (1935)]. Agreement with observation is good. The epicentre was at 135°·40 E, 34°·60 N, and focal depth 360 km. The initial motion of P waves at points N.E. of a line from N. 35° W. to S. 35° E. through the epicentre was downwards and the wave rarefactional, S.W. of this line upwards and the wave condensational. C. A. S.

2487. Comparison of Displacement, Velocity, and Acceleration Seismograms. T. Hagiwara. *Tokyo Univ. Earthquake Research Inst., Bull.* 13. *pp.* 138–145, *March*, 1935. *In English.*—The seismograph records of the same earthquake (of Sept. 1, 1934), as obtained by (I) a displacement seismograph designed by the author (figured and briefly described), (II) the author's velocity seismograph [see Abstract 1082 (1935)], and (III) Ishimoto's acceleration seismograph [see Abstract 355 (1932)] are reproduced, and the records (I), (II) and (III) compared respectively with the displacement curve deduced from (II), the velocity curves deduced from (I) to (III), and the acceleration curve deduced from (II). It is inferred that the chief cause of error is deviation in the zero lines of the original curves. C. A. S.

TERRESTRIAL ELECTRICITY AND MAGNETISM.

2488. New Process in Lightning Tracks. B. Walter. *Ann. d. Physik*, 22. 4. *pp.* 421–424, *March*, 1935.—The author outlines the facts discovered by Schonland and Collens [see Abstract 1066 (1934)] and refers to his earlier papers published in 1898 and 1902 in which he mentioned this impulsive type of discharge and the lateral ramifications of the flash produced after the initial discharge. He considers that Schonland and Collens' views are not conclusive and that the effect of electricity induced on the earth by the cloud has been neglected. The presence of this electricity, its renewal between individual flashes, and the poor conductivity of the earth which may differ considerably in various directions, are important factors in explaining the processes. He also finds this process acts whether the cloud is positive or negative and it helps to explain the different rates of the downward and upward flashes. R. S. R.

***2489. Simultaneous Measurements of the Different Elements of Atmospheric Electricity. (Miss) O. Thellier.** *Comptes Rendus*, 200. *pp.* 1124–1127, *March* 25, 1935.—The elements measured are the electrical conductivity, the numbers of both large and small ions, the nuclei of condensation and the particles in suspension in the air. The aim of the investigation is to determine precisely the periodic and the accidental variations of these elements and the relations between them. For this purpose measurements must be made rapidly. The methods of obtaining values for the different elements is described. A slight modification of a method already described [see Abstract 3455 (1933)] was used in finding the conductivity. Thereafter a description is given of the arrangement of the apparatus to enable rapid observations to be taken of all the different elements. Measurements were carried out for six months; the results for one week are set out in tabular form. A. E. M. G.

2490. Electrical Conductivity of the Air and the Danger of Lightning. R. Gibrat and G. Viel. *Comptes Rendus*, 200. *pp.* 1233–1235, *April* 1, 1935.—From measurements of the electrical conductivity of the air carried out recently by G. Viel, the authors have been able to establish relationships between the conductivity and the danger from lightning stroke. They denote by s the total conductivity and by r the ratio of conductivity due to negative ions to that due to positive ions. A number of conclusions concerning these quantities, their relationship to each other and the information they give regarding places where lightning discharges are likely or not are given. Also if D denote the danger arising from lightning a formula has been established giving, over a distance x, $D(x) = kx^m$ where k and m are constants. A. E. M. G.

2491. Amplitude of Semi-Diurnal Component of Terrestrial Electrical Potential Gradient and Solar Activity. R. Guizonnier. *Comptes Rendus*, 200. *pp.* 1235–1236, *April* 1, 1935.—The method of analysis used to obtain the semi-diurnal component, A^1 is the same as used already by the author in the study of the diurnal, viz., by starting from the mean monthly hourly values. These curves expressing A^1 show a remarkable parallelism with those which give the mean monthly values of the surface of sunspots. Examples of both sets of curves are given. But when A^1 is obtained from the mean annual hourly values for the stations, Ebre, Kew and Eskdalemuir, only those for Ebre show parallelism with the mean annual value of the surface of the sunspots.

A. E. M. G.

***2492. Apparatus for the Determination of Atmospheric Potential Gradient and its Action under Extreme Outside Conditions. J. Scholz.** *Zeits. f. Instrumentenk*, 55. *pp.* 157–166, *April*, 1935.—In Franz-Josef Land during the Polar Year, 1932–3, the following forms of apparatus were used: (1) Wilson apparatus with vertical collecting plate, (2) registering Benndorf electrometer with the needle connected to a polonium collector, and (3) Lutz electrometer also connected to the polonium collector and used for eye readings. During cold weather great difficulty was experienced with the hourly contacts, thickening of the sulphuric acid, and other insulators. Potential gradient values from the three instruments show large variations from one another which are due to the method of erection. The reduction of potential gradient values to the free surface is constant for the Wilson apparatus, but a functional relation exists for the Benndorf apparatus since the collector was over the roof of the building and was not perpendicular to the field lines. It was found that the Wilson apparatus was suitable in strongly converging or diverging fields, but with radioactive collectors the reduction factor to the free plane must be found. The Wilson apparatus shows the existence of a contact potential which falsifies values for the vertical air current.

R. S. R.

2493. Simultaneous Measurements of Numbers of Ions, Potential Gradient and Vertical Atmospheric Conductivity. J. Scholz. *Gerlands Beitr. z. Geophys.* 44. 1. *pp.* 86–97, 1935.—Two ionic counters with different methods of action were used to investigate the content of the ionic spectrum at Franz-Josef Land. It was established that in the Arctic extraordinarily few condensation nuclei and large ions were present, but apart from small ions of mobility $(k) = 1\cdot4$ cms./sec. : volts/cm., many ions occurred with mean mobility $= 10^{-2}$. Simultaneously with a Wilson apparatus values were found for the potential gradient (Λ) and air current. It was found that (1) the conductivity (air current/potential gradient) is in the mean equal to the polar positive conductivity, λ_+, found with the ionic counters, and (2) comparison of conductivities $\lambda_\pm$ and potential gradients $\Lambda_\pm$ for middle ions $(k = 10^{-2})$ showed that $\lambda_\pm$ and $\Lambda_\pm$ varied in the same sense. This leads to the belief that in the atmosphere, and especially in the Arctic, another ionising agent, probably the Lenard effect, must be present. R. S. R.

2494. Registration of Electric Space Charge of Air by Potential Measurements near Buildings. H. Deutschländer. *Gerlands Beitr. z. Geophys.* 44. 1. *pp.* 16–39, 1935.—Benndorf electrometers are used to measure the change in electric field near buildings, this is reduced by Poisson's equation to the space charge. The constants of the equation are determined by a cage method. Errors due to difficulty in procuring sufficiently good insulation are considered and, while the apparatus is incapable of showing quick changes in the space charge, yet with care and time, average charges can be measured with considerable accuracy. A table is given in which the space charges are compared with the field strengths for different types of air, under different conditions. H. M. B.

2495. Auroral Phenomena and World-Wide Magnetic Disturbances. A. Rostad. *Geofysiske Publ.* 10. *No.* 10 [10 *pp.*], 1935.—After referring to two previous publications dealing with the southerly extension of the aurora and a linear relation established between the intensity of magnetic disturbances and the pole distance of the aurora for data from Potsdam the author discusses the difficulty of obtaining a definite value for the pole distance useful for the present investigation. The relation between the pole distance Θ, and the intensity of the magnetic disturbances P is then considered. Results from stations comparatively near the pole are not suitable as shown by curves drawn for Potsdam and Rude Skov (Denmark). On the other hand observations from equatorial stations may be used. The method of finding a value for P from the observations of five equatorial stations is given, and the values of P so found plotted in diagrams for days on which aurora occurred, the observations extending over a period of years. This enables a graph to be constructed giving the relation between P and Θ and another between P and the southward extension of the aurora. The latter has a greater curvature than the former. The results so found are discussed, and also the relation of Θ to the alteration of the earth's magnetic field from causes remote from the earth. A. E. M. G.

See also Abstracts **2393, 2470.**

RADIOACTIVITY.

2496. Radioactivity of Potassium and Rubidium. F. H. Newman and H. J. Walke. *Phil. Mag.* 19. *pp.* 767–773, *April*, 1935.—It is suggested that the radioactivity of K consists in a single β-ray transformation, and that the two β-ray components [see Abstract 4026 (1933)] are due to internal conversion of a nuclear γ-ray resulting from the β-ray transformation. Thus the activity is due to emission of a single negative electron from $K_{19}^{40 \text{ or } 42}$. This might be formed by any of the following reactions: $K_{19}^{39\,(41)} + n \rightarrow K_{19}^{40\,(42)}$; $Ca_{20}^{40\,(42)} + n \rightarrow K_{19}^{40\,(42)} + \overset{\nearrow}{p}$; or $Sc_{21}^{45} + n \rightarrow K_{19}^{42} + \overset{\nearrow}{\alpha}$. In view of the greater abundance of K_{14}^{39} and Ca_{21}^{40}, and the stability of A_{18}^{40}, and Ca_{20}^{40}, K_{19}^{40} is the more probable origin. Similarly for Rb: $Rb_{37}^{85\,(87)} + n \rightarrow Rb_{37}^{86\,(88)}$; $Sr_{38}^{86\,(87,\,88)} + n \rightarrow Rb_{37}^{86\,(87,\,88)} + \overset{\nearrow}{p}$; or $Y_{39}^{89} + n \rightarrow Rb_{37}^{86} + \overset{\nearrow}{\alpha}$; the stability of Kr_{36}^{86} and Sr_{38}^{86} favour Rb_{37}^{86} as the reactive isotope. C. A. S.

2497. Radioactivity of the Rare Earths. H. J. Walke. *Phil. Mag.* 19. *pp.* 878–886, *May*, 1935.—The author has previously shown that most of the main isotopic species can be built up by a process of neutron capture and β-radioactivity of certain missing isotopes. In the present paper the radioactivity and nuclear synthesis of some of the rare earths is considered in the light of Aston's recent results. W. E. P.

2498. Energies of α- and γ-Rays. H. A. Wilson. *Roy. Soc., Proc.* 150*A*. *pp.* 1–8, *May* 1, 1935.—Reasons for believing that α- and γ-ray energies involve electronic energy are given. It is pointed out that if these reasons are valid then Gamow's theory requires modification. The modification proposed in previous papers [see Abstract 4954 (1934)], namely that α- and γ-ray energies are equal to nuclear energy changes plus electronic energy changes, is discussed and an attempt is made to show that it is not necessarily in conflict with current theoretical ideas based on quantum mechanics. The expression $nq \pm C_m$, where $n = 1, 2, 3 \ldots$, $q = 3{\cdot}85$ and C_m is a constant, for the energy of a γ-ray is compared with Rutherford and Ellis's expression $nE_1 - pE_2$, where n and p are integers and E_1 and E_2 constants equal to nuclear energy changes. It is suggested that the term pE_2 represents electronic energy, so that the nuclear changes are equal to nE_1 or nq if $q = E_1$. A set of energy levels and transitions for radium C′ based on the theory proposed is suggested analogous to those of Rutherford, Lewis and Bowden and of Ellis. AUTHOR.

2499. D.C. and A.C. in the Flow Method of Measuring the Radioactivity of the Air. G. Aliverti and G. Rosa. *N. Cimento*, 12. *pp.* 26–35, *Jan.*, 1935.—Using Aliverti's apparatus with a.c. and d.c., it is found that $N_1/N_0 = 0{\cdot}915$, where N_1 is the number of radioactive atoms in the air when a.c. is used and N_0 with d.c. This discrepancy is investigated and is found to be due to the number of radioactive atoms deposited on the walls of the vessels being larger in the case of the a.c. than in the d.c. In both cases the values of N are shown to be lower than the true number of radioactive atoms in the atmosphere. H. M. B.

See also Abstracts 2323, 2688, 2689, 2738.

RADIATION.

ABSORPTION AND TRANSMISSION.

***2500. Filter for Obtaining Light at Wave-Length 560 mμ. K. S. Gibson.** *J.O.S.A.* 25. *pp.* 131–135, *May*, 1935. *Bureau of Standards, J. of Research*, 14. *pp.* 545–552, *May*, 1935.—A filter transmitting a narrow band of light at 560 mμ is of particular importance in the colorimetry of sugar solutions, in optical pyrometry, in abridged spectrophotometry, and in photometry. A new 4-component glass filter has been designed which isolates and transmits light at 560 mμ more effectively than previous filters. Two components of this filter are of Corning glass and two of Jena glass. The spectral transmissions of the filter and its components are illustrated. The spectral centroid of the light transmitted by the filter is at 560 mμ for both incandescent and daylight illuminants. Various other luminous characteristics of the filter are also defined and values given. AUTHOR.

See also Abstracts 2476, 2504.

COLORIMETRY.

2501. Extended Theory of Colorimetry. P. J. Bouma and G. Heller. *K. Akad. Amsterdam, Proc.* 38. 3. *pp.* 258–271, 1935. *In German.*—A continuation of two previous papers [see Abstract 1557 (1935)] dealing principally with the forms of the expression for a given light and the transformation from one set of primaries to another. J. W. T. W.

See also Abstract 2600.

ELECTRO-OPTICAL AND MAGNETO-OPTICAL EFFECTS.

2502. Kerr Effect in Polar Molecules. O. Specchia and N. Dallaporta. *N. Cimento*, 12. *pp.* 15–25, *Jan.*, 1935.—Theories are given which show that the constant of the Kerr effect may be represented as the sum of two constants, one depending on the polarity of the molecules. The latter constant may be positive or negative and so, if predominant, gives negative results. The constant for substances with polar molecules varies parabolically with temperature. This is verified experimentally for castor oil and shows a similar slight deviation as has previously been noted by Raman for other substances. The results are obtained by comparison with CS_2 of which the constant is already known. H. M. B.

2503. Faraday Effect of Strong Electrolytes in Aqueous Solutions. Part III. A. Okazaki. *Ryojun Coll. Eng., Mem.* 8. [29 *pp.*], *Jan.*, 1935. *In English.*—In continuation, 17 electrolytes were investigated which consisted of uni-bivalent, bi-bivalent and uni-trivalent compounds [see Abstract 1100 (1935)]. The relation between the magneto-optical rotation and the concentration was measured for these for a wavelength in the ultra-violet. The specific rotation of most of the electrolytes is nearly independent of the concentration, or shows a tendency to decrease with increasing concentration, the most remarkable decrease being observed for $AlCl_3$. With H_2SO_4 and $Zn(NO_3)_2$ it tends to increase with concentration. The magneto-optical dispersion of the electrolytes in given concentration was determined for the range λ5900 to λ3400. From this the rotatory dispersions of some bi- and tri-valent ions were derived. G. E. A.

FLUORESCENCE AND PHOSPHORESCENCE. LUMINESCENCE AND AFTERGLOW.

2504. Absorption and Fluorescence of the Vapours of Copper Halides. J. Terrien. *Comptes Rendus,* 200. *pp.* 1096–1098, *March* 25, 1935.—CuCl vapour was found to show a continuous absorption in the ultra-violet with a maximum at λ2230 and a further rise beyond λ2150, in addition to the absorption band systems in the visible spectrum observed by Ritschl. The continuous absorption is attributed to polymerised molecules Cu_2Cl_2 and is accompanied by fluorescent emission of the band systems in the visible region. CuBr exhibits similar effects. W. S. S.

2505. Infra-Red Fluorescence of Green Leaves. C. Dhéré and Anne Raffy. *Comptes Rendus,* 200. *pp.* 1146–1148, *March* 25, 1935.—Shows that the striking results obtained when a landscape is photographed using a plate sensitised for the near infra-red, and the short wave-lengths removed by a suitable filter, is not due to the high infra-red reflection of chlorophyll but to an infra-red fluorescence. This is shown by a spectrographic examination of the light emitted by leaves illuminated with blue, violet and ultra-violet rays only. R. C. F.

2506. Polarisation of the Fluorescence Bands of Hg Vapour. G. Zieliński. *Comptes Rendus,* 200. *pp.* 1313–1314, *April* 8, 1935.—In continuation of previous work [see Abstract 155 (1934)] on the fluorescence of saturated Hg vapour it is found that the bands at 2540 and 2650 Å are partially polarised in the plane containing the direction of the incident (exciting) beam and that of observation. At right angles to the incident beam the degree of polarisation is about 5·5 %. No polarisation is observed in the bands at 3300 and 4850 Å. It is concluded that all the fluorescence bands which appear in absorption are partially polarised, whilst those not appearing in absorption are not polarised. In the former case, the degree of polarisation is independent of pressure over a wide range. C. B. A.

2507. Effect of a Magnetic Field upon the Fluorescence of Diatomic Selenium Molecules. J. Genard. *Physica,* 2. *pp.* 328–334, *April,* 1935. *In French.*—An account is given of photometric measurements of the effect of a magnetic field upon the fluorescence of diatomic selenium molecules excited at 600° C. by Hg 4047 and 4358 Å. Field strengths up to 43,800 gauss are applied by means of the large Paris electromagnet. The spectrograph used has a dispersion of 15 Å per mm. in the region under observation. Microphotometer curves are reproduced for field strengths zero and maximum. The results [see Abstract 4967 (1934)] cannot be explained as due simply to a Zeeman effect in the absorption spectrum of the vapour. L. A. W.

2508. Luminescence of Minerals Excited by X-Rays. E. Iwase. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers No.* 565. *pp.* 258–275, *March,* 1935. *In German.*—The luminescence of minerals produced by irradiation with X-rays was investigated by a photographic method. The test pieces examined were a yellowish green fluorspar, light brown calcite, colourless fluorspar and light yellow apatite. It was already known that the first two specimens show solarisation through mercury arc light, *i.e.,* during illumination with mercury light the luminosity at first gradually increases so that certain maxima appear and then decreases. On the contrary it was found that the intensity of the X-ray luminescence of all the specimens examined rises with increasing duration of irradiation and finally converges to a limiting value. Thus no solarisation occurred in the X-ray luminescence. X-rays produce stronger luminescence of the minerals than does mercury light, and in consequence the X-ray luminescence lasted much longer than that due to mercury light. The brightness of the X-ray luminescence was diminished by previous heating. J. J. S.

2509. Oxygen Afterglow. (Lord) Rayleigh. *Roy. Soc., Proc.* 150*A*. *pp*. 34–36, *May* 1, 1935.—The author draws attention to his previous work on the oxygen afterglow [see Abstract 570 (1912)] which he states has escaped Stoddard's notice [see Abstract 240 (1935)]. The conclusions formerly reached are not in agreement with those recorded in Stoddard's recent paper (*loc. cit.*) and the author now wishes to draw attention to the old experiments. First he explains what is meant by the expression "electrodeless discharge" since Stoddard has used various types of discharge and the present author employed solely the ring discharge as obtained by J. J. Thomson by electromagnetic induction. Stoddard's conclusion that the so-called oxygen afterglow is in reality only obtained when traces of nitrogen are present is contested by the author, who has demonstrated the absence of nitrogen spectrographically, while he has shown that when the water vapour band and the Hα line were removed by the action of phosphorus pentoxide or by freezing out with liquid air, the afterglow disappeared with them. Stoddard's failure to obtain the afterglow in moist oxygen is ascribed to his having used an unsuitable kind of discharge. H. H. Ho.

2510. Blue Glow on Surfaces at − 180° C. Attributed to NH or NH_2 Molecules. R. W. Lunt and J. E. Mills. *Faraday Soc., Trans.* 31. *pp*. 786–791, *May*, 1935.—It has been confirmed that a blue glow occurs when the gases from a discharge in a stream of highly purified ammonia at low pressure are led over a surface cooled to − 180° C. The mechanism most consistent with the available data is that the emission arises from two excited NH_2 molecules resulting from the decomposition of a hydrazine molecule itself formed from the reaction between two $^1\Delta$ NH molecules and a hydrogen molecule in the ground state. AUTHORS.

See also Abstracts 2607, 2608, 2613.

INTERFERENCE. DIFFRACTION AND SCATTERING.

2511. Iridescent Shells. Parts I and II. C. V. Raman. *Indian Acad. Sci., Proc.* 1. *pp*. 567–589, *March*, 1935.—Part I forms an introduction to this series of papers. It reviews the various optical, crystallographic. colloid-chemical and zoological points of view from which the study of iridescent shells is of interest, the available material, and the previous literature. Part II deals with colours of laminar diffraction. The phenomena with iridescent shells differ from those observed with stratified films in (*a*) the inclination of the laminæ to the external surface, (*b*) their granular structure, (*c*) the thickness of the material. Brewster's classification of mother-of-pearl colours is shown to have no theoretical justification. Theory and experiment show that the characteristic iridescence of shells is a diffraction effect which appears as one of the orders of spectra produced by the periodic structure at the surface. The distribution of intensity in the diffraction spectra, and the effect on it of grinding and polishing the surface, are considered, and the surface phenomena observed under hollow-cone illumination in the ultra-opak microscope are described and correlated with the intensity distribution and with the asymmetrical diffraction by laminar edges. Other laminar diffraction phenomena are discussed and are shown to support the view that the nacre consists of layers of aragonite crystals separated by immeasurably thin layers of organic matter. Numerous photographs are reproduced. C. B. A.

2512. Rayleigh Scattering in Liquids under High Resolving Power. B. V. R. Rao. *Indian Acad. Sci., Proc.* 1*A. pp.* 473–483, *Feb.*, 1935.—The Rayleigh scattered lines in liquids are accompanied by Doppler components due to elastic waves in the liquid. These lines are observed for CCl_4 and toluene, and are always weaker than the original line. It is pointed out that this leads to the conclusion that the anisotropy is not mainly responsible for the appearance of the central undisplaced component. The red shift reported by Cabannes is regarded as spurious. [See following Abstract.] A. C. M.

2513. Splitting of Spectral Lines by Scattering in Liquids. S. M. Mitra and S. Mehta. *Ann. d. Physik*, 22. 3. *pp.* 311–312, *March*, 1935.—Cabannes and others have found that a small shift to the red occurs when light is scattered by liquids and gases. Gross on the other hand, found no shift, but a symmetrical array of faint lines on each side of the original line, and attributed them to the effect of elastic waves in the medium. Others have found results agreeing with the work of Cabannes or Gross. The authors used a Fabry-Perot interferometer and a specially built glass spectrograph. They observed at angles of 45°, 90° and 135° the scattering of the wave-length 4358 Å of mercury by CS_2 and by benzene. Microphotometer records show that there is a line on each side of the original line, agreeing with the work of Gross. The shift is, however, slightly in excess of the theoretical shift, and the higher components observed by Gross were not found. [See preceding Abstract.] A. C. M.

2514. Light Scattering by Opal Glass. M. Minnaert. *Physica*, 2. *pp.* 363–378, *April*, 1935. *In German. English Abstract.*—The distribution of the light, scattered by a thick plate of opal glass without absorption, is calculated to a first approximation. When the influence of the reflections at the boundaries is taken into account, it is found that the scattered light would be nearly isotropic on both sides, if not for the reflection factor of Fresnel, which practically determines the distribution. When the boundary reflections are eliminated by immersion in a suitable liquid, and the opal glass is illuminated and observed under grazing incidence, the distribution of the light scattered backward is substantially equivalent to that of the light scattered by one single particle. By this method it is possible to determine easily the diameter of the scattering particles (from 0.3 to 0.7 μ). AUTHOR.

See also Abstracts 2476, 2539, 2666.

PHOTOCHEMISTRY (INCLUDING PHOTOGRAPHY).

***2515. Contrast Microphotometer. F. W. Sears.** *J.O.S.A.* 25. *pp.* 162–164, *May*, 1935.—An instrument is described which measures directly the rate of change across a photographic plate of the density of the image. An orthodox microphotometric system is used, but on the translational motion of the plate is superimposed a vibration, in the same direction, of very small amplitude (0·01 to 1 mm.). The light intensity falling on the photo-cell is therefore alternating for those parts of the plate where the image density is changing, and an a.c. amplifier connected to the cell shows an output which is a measure of the rate of change of density. The instrument is useful for the analysis of plates showing very small contrast, as in electron diffraction images. D. H. F.

2516. Effect of Kations on Sensitiveness of Photographic Emulsions. A. Charriou and (Miss) S. Valette. *Comptes Rendus,* 200. *pp.* 1189–1191, *April* 1, 1935.—To a series of otherwise identical iodobromide emulsions (4·65 % AgI, 1800 H. & D.) various metallic salts (chloride, nitrate or sulphate) were added before pouring, in the proportion of 0·00001–0·24 mol. per mol. AgBr, and the sensitiveness of the plates made therefrom compared with plates from the original emulsion. The anion had no effect, but the kations were divisible into four classes: (*a*) with no action, Cd, Al, Mg; (*b*) causing a decrease of sensitiveness (in decreasing order of efficiency) (i) with destruction of chemical fog, Th, Fe″, Zr, As, Pb, Co, Cu, (ii) with formation of chemical fog, Tl′, UO$_2$, Au, Fe″, Hg″; and (*c*) causing an increase in sensitiveness, Hg′, Fe″ (at low concentration), Ag. C. A. S.

2517. New Sensitisers for the Photography of the Infra-Red; Tetra- and Pentacarbocyanines. L. G. S. Brooker and G. H. Keyes. *Kodak Research Lab. Comm. No.* 543. *Frank. Inst., J.* 219. *pp.* 255–261, *March,* 1935. *Phot. Indust.* 33. *pp.* 335–336, *April* 10, 1935. *Phot. J.* 75. *pp.* 191–194, *April,* 1935.—By lengthening the carbon chain in the cyanine dyes their absorption, and thus sensitising, bands, appear further out in the infra-red. The preparation of the new dyes is very briefly dealt with, the tetracarbocyanine containing a 9-carbon chain and the pentacarbocyanine an 11-carbon chain. Wedge spectrograms of 4 tetracarbocyanine and 3 pentacarbocyanine dyes are given, showing for the former a range of from 7600 Å—10,000 Å approximately, with a maximum at about 9600 Å, and for the latter extremely broad sensitising bands with a maximum at about 10,500 Å or 11,000 Å. These dyes are difficult to prepare in a pure state and in many cases cannot be recrystallised. [See Abstract 2062 (1935).] R. C. F.

PHOTOMETRY.

***2518. Photometer for Measuring Atmospheric Transmission Near the Ground. F. Löhle.** *Zeits. f. techn. Physik,* 16. 3. *pp.* 73–76, 1935.—A photometer is described in which the scattering coefficient of the atmosphere is determined by measuring the surface brightness of a nearly black natural object (*e.g.*, a wooded hillside), light from the horizon providing the comparison beam. The principles involved in this measurement, the use of the instrument, and sources of error are described.

D. H. F.

***2519. Filters for Colour-Temperature Determinations. F. Benford.** *J.O.S.A.* 25. *pp.* 136–141, *May,* 1935.—When a number of colour filters are placed in "series," the transmitted light consists not only of that passing straight through the combination but also contains that which has suffered an even number of inter-reflections at the various interfaces of the filters. Even in a single filter the ray that has suffered two inter-reflections at the surfaces of the glass is of importance. The author shows how this phenomenon may be used to obtain a closely-spaced scale of colour-temperatures from a relatively small number of suitable colour filters (including one or more neutrals). The order in which the filters are placed is of importance. J. W. T. W.

***2520. Heterochromatic Photometry Using Colour Filters and Photocells. H. König.** *Helv. Phys. Acta,* 8. 2. *pp.* 211–224, 1935. *In German.*—Although no single colour filter will give a good approximation to the spectral transmission curve needed to change light from one colour temperature to another, an additive combination of a small number of different filters will do so, *i.e.*, if appropriate amounts of the light transmitted by each filter separately could be added, the result would be very nearly that required. The author proposes the use of a method of heterochromatic photometry based on this principle. The light from a lamp is measured both unfiltered and after transmission through various colour filters of suitably selected spectral transmissions. The measurements are made one after the other, using a suitable type of photoelectric cell. The results, after multiplication by the factors appropriate to the respective filters, are added and thus the ratio of the candle-powers of any two lamps giving lights of different colour temperatures may be found. J. W. T. W.

***2521. Low Intensity Light Measurements with Photon-Counters. Part I. K. H. Kreuchen.** *Zeits. f. Physik*, 94. 9–10. *pp.* 549–566, *April* 16, 1935.—Spectral sensitivity characteristics of photon-counters with kathodes of Al, Zn, Cd, Fe and Cu were determined in the region 400–254 mμ, and were found to correspond with those for the same metals in ordinary photo-cells. Brass was also used as a kathode; its characteristics were found to resemble those of Zn. The apparatus used is fully described. An apparatus for the region 248–185 mμ is also described [see Abstract 1121 (1934)]. D. H. F.

See also Abstract 2515.

POLARISATION.

2522. Circular Dichroism and Physico-Chemical Applications. J. P. Mathieu. *Ann. de Physique*, 3. *pp.* 371–460, *April*, 1935.—Two methods of measuring circular dichroism (a particular case of the analysis of weak ellipticities), are described. The first, for use in the visible spectrum, employs a linear half-shade analyser in combination with a birefringent compensating plate. The second, which is particularly adapted for ultra-violet wave-lengths from 4500 Å to 2800 Å, is a modification of Brace's method, combining a half-shade of the Bravais type with a rotating compensator. These methods are applied, in parallel with other physico-chemical methods, to a study of chromium-tartaric acid complexes. In acid solution, addition of chromium hydroxide to tartaric acid produces a normal chromium tartrate, which passes over spontaneously into a chromotartrate complex. In addition to the other physico-chemical evidence (pH, absorption spectrum, optical activity), this change is associated with the appearance of circular dichroism, the study of which shows that the complex formed is unique, that it contains one atom of Cr for each molecule of acid, and that its production is a second order reaction. In alkaline solution, the complex behaves as a weak acid, and an alkali chromotartrate is produced. The circular dichroism of this is employed to establish its composition and the effect of other factors on its equilibrium with the alkali tartrate present. C. B. A.

2523. Theory of Optical Activity. M. Born. *Roy. Soc., Proc.* 150*A*. *pp.* 84–105, *May* 1, 1935.—This paper contains a detailed development of the theory of rotatory power given by the author in 1915. The molecule is considered as consisting of a set of isotropic oscillators coupled by Coulomb forces. The interaction is calculated by the perturbation method. The resultant formula is rather complicated but can be simplified very much for special cases. A molecule consisting of two equal pairs of oscillators perpendicular to one another and to their central line is worked out in detail; it gives the angle of rotation of the expected order of magnitude. **Author.**

See also Abstracts 2506, 2539.

RADIATION, EMISSION.

2524. Equilibrium of Black-Body Radiation. W. Heitler. *Cambridge Phil. Soc., Proc.* 31. *pp.* 242–243, *April*, 1935.—From the recent deduction that two light quanta with total energy not less than 2 mc^2 can create a pair of electrons, it follows that ordinary black-body radiation no longer represents an equilibrium state. In this paper is calculated the variation of electron density with temperature, in thermodynamic equilibrium. Corresponding mass density is discussed in relation to the white dwarfs at about 10^9–10^{10} °C. N. M. B.

2525. Interaction of Radio Waves. V. A. Bailey and D. F. Martyn. *Wireless Engineer*, 12. *pp.* 122–125, *March*, 1935.—The authors in this paper present a brief theoretical discussion of the "Luxembourg effect." This effect was first observed by Tellgen in Holland, who noticed that while receiving signals from Beromunster (461 m.) the programme of Luxembourg (1190 m.) could be faintly heard. The hypothesis put forward that the effect was due to an interaction of the waves in the ionosphere has since been supported by many other observations. As a consequence of the theory developed the authors state that observers listening to Luxembourg at such a distance that the sky wave only is received should notice a distortion of the programme which would take the form of a relative weakness of the low notes. The same effect should also be noticeable in parts of the British Isles in respect of the Droitwich transmitter. [See also Abstract 4172 (1934).] F. S. B.

2526. Rotating Electromagnetic Waves. N. S. Japolsky. *Phil. Mag.* 19. *pp.* 934–958, *May*, 1935.—Electromagnetic waves are discussed which are axially symmetrical and propagate along the axis of symmetry with the velocity greater than that of ordinary plane waves with constant amplitude, and simultaneously rotate about this axis. These waves are called "super-fast rotating cylindrical waves." Different states of polarisation of these waves are considered. Combinations of co-axial wave-trains of this kind with the same wave-length and frequency but different angular velocities of rotation are called "compound" waves. A particular case of compound waves leading to waves having the energy concentrated in the plane of symmetry (principal plane) is discussed. This kind of compound waves is called "planar" waves. The rotating cylindrical waves are compared with the de Broglie material waves, and an assumption is considered that the former waves or their combination may play the part of the latter. It is hinted that the rotating cylindrical waves or their combination may be used for approximate representation of the structure of optical waves. **Author.**

2527. Multi-Frequency Ionospheric Recording and Its Significance. T. R. Gilliland. *Bureau of Standards, J. of Research*, 14. *pp.* 283–303, *March*, 1935.—Results are given of hourly measurement of critical frequencies for the period May, 1933, to April, 1934. The critical frequencies were obtained by an automatic recorder covering the range 2500 to 4400 kc./s. at a speed of 200 kc./s. per min. The critical frequencies for the E- and F-layers follow in phase with the sun both diurnally and seasonally. In the day fine structure is in evidence between the E- and F-layers. The F-layer during the winter night shows a minimum critical frequency near midnight, which then increases to a maximum at about 40 m., and then falls to a second minimum before sunrise. This increase during the night corresponds to more than a 100 % increase of maximum electron density. F. S. B.

2528. Propagation of Electric Waves in the Earth's Magnetic Field. T. Ionescu and C. Mihul. *Comptes Rendus,* 200. *pp.* 1301–1303, *April* 8, 1935.—In previous papers [see Abstracts 704 and 705 (1935)] no account was taken of the effect of the earth's magnetic field, which shows itself in the doubling of ionospheric echoes. From consideration of published experimental results the following general conclusions can be drawn: (*a*) the magnetic field only gives two components; (*b*) the doubling is more pronounced in high latitudes than in the tropical zone; (*c*) as a rule, the two components have the character of wave circularly polarised in opposite senses. It appears that the Faraday effect, due to the action of the vertical component of the earth's magnetic field, is here concerned, the complete separation of the two circular components being due principally to the fact that their group velocities differ greatly, especially at heights where *t*, the time between consecutive impacts of an electron with gas molecules, is a whole multiple of the period T. Formulæ are derived for the dielectric constant and the conductivity for the two circular components and from these curves may be obtained showing the apparent reflection heights for the two components. The results are briefly discussed in relation to the experimental results of Berkner and Wells, Huancayo, Pérou and Appleton. A. W.

2529. Properties of Cosmic Ray Components. P. Auger, A. Rosenberg and F. Bertein. *Comptes Rendus,* 200. *pp.* 1022–1024, *March* 18, 1935.—Coincidence counting experiments are described on the absorption of cosmic rays by lead at 8½ m. depth in the earth, and by lead and copper at sea level; and on the production of showers at the same levels. [See Abstracts 1597 and 2080 (1935).] D. H. F.

***2530. New Secondary Effect of Cosmic Radiation. M. Ackemann.** *Zeits. f. Physik,* 94. 5–6. *pp.* 303–316, *April* 2, 1935.—A new arrangement of two counters for investigating the production of secondaries in Pb, by coincidence registration, is proposed. It consists of two counters, with their axes in the same horizontal plane, close beneath a very wide sheet of Pb. Using this arrangement the variation of secondary production with Pb thickness was determined for Pb thicknesses up to 22 cm. In addition to the usual maximum at about 1·5 cm. of Pb, another is recorded at a thickness of about 18 cm. This result is discussed and interpretations suggested. The construction of counters, and the Bothe and Hummel circuits for coincidence registration, are discussed. **Errata,** *ibid.,* 11. 12. *p.* 816, *May* 3, 1935. D. H. F.

2531. Nature of Cosmic Radiation. W. F. G. Swann. *Phys. Rev.* 47. *pp.* 575–577, *April* 15, 1935.—If it is assumed that cosmic rays of a wide range of energy enter the atmosphere, and if it is accepted that the intensity, defined by the number of rays per sq. cm. per sec. per unit solid angle, increases exponentially with altitude, then, the author shows, it follows that the quality of the radiation is independent of the altitude. It is then difficult to account for the fact that the rate of increase with altitude in the number of showers produced in Pb is greater than that of the increase in intensity of the primary radiation. It is shown that this fact can be explained on the assumption that the secondary-producing efficiency of a primary ray is proportional to the energy in the case of air, and to a higher power of the energy in the case of Pb. D. H. F.

2532. Intensity Variation of Cosmic-Ray Showers and Vertical Rays with Barometric Pressure. E. C. Stevenson and T. H. Johnson. *Phys. Rev.* 47. *pp.* 578–579, *April* 15, 1935.—Using three Geiger-Müller counters in triangular arrangement below a lead plate 1·2 cm. thick, cosmic-ray shower intensities at sea level were found to diminish with increasing barometer by the factor 0·00542 ± 0·00027 per mm. mercury, corresponding to an exponential absorption coefficient of 0·41 per metre of water. Vertical rays measured with three counters in line showed a barometer effect of 0·00362 ± 0·00044 per mm. mercury or 0·28 per metre of water. The showers are thus more sensitive to barometric changes than the total cosmic radiation as had been found by experiments at different elevations. AUTHORS.

2533. Longitude Effect of Cosmic Radiation. M. S. Vallarta. *Phys. Rev.* 47. *pp.* 647–651, *May* 1, 1935.—It is shown that if the equivalent magnetic dipole describing the earth's magnetic field at large distances is placed at the magnetic centre of the earth as calculated by Schmidt, the theory of the latitude and azimuthal effects developed by Lemaître and Vallarta also accounts for the longitude effect found by Clay, van Alphen and 't Hooft and, independently, by Millikan and Neher [see Abstract 1126 (1935)]. Further it is shown that if the distribution function of magnetically deflectable particles capable of reaching the earth's tropical belt is substantially an exponentially decreasing function of their energy, the theory quantitatively agrees with experiment. AUTHOR.

2534. Variation of Penetrative Power of Cosmic Radiation with Magnetic Latitude. Energy Distribution of the Particles. J. Clay. *Physica,* 2. *pp.* 299–308, *April,* 1935. *In English.*—In order to test the supposition that the penetrative power of the primary cosmic rays decreases with latitude, a series of observations was made at different latitudes. These absorption measurements were carried out in a big water-tank of 1000 m.^{3} on board the M.S. *Tajandoen,* going from Amsterdam to Batavia. Measurements were made above the water and at depths of 50, 250, 450 and 690 cm. At this latter depth the ionisation was recorded during the voyage. The accuracy of the measurements was better than 1 % and for the last series better than 0·5 %. It was shown that the penetrative power increased towards the equator. The latitude, where the energy range cut off by the layer and by the earth's magnetic field is the same, was determined in each case. Considering these results and those of the counter measurements it is very probable that the distribution is continuous. For the first water layers the variation of the intensity with the thickness of the layer is rather complicated. AUTHOR.

2535. Electromagnetic Radiations. (Lord) Rutherford. *Engineering,* 139. *pp.* 314–316, *March* 22; 341–342, *March* 29; 357–358, *April* 5, *and pp.* 434–436, *April* 26, 1935. *Lectures delivered at the Royal Inst.*—In the first lecture a brief historical account is given of the development of our knowledge of the properties of electromagnetic waves, particularly of the type now employed in radio communication. The second lecture deals in a similar manner with infra-red radiation and also certain features of visible radiation, such as selective scattering and the production of the Fraunhofer lines in the solar spectrum. Visible radiation, phosphorescence and the properties of ultra-violet light are considered in the third lecture, together with the photoelectric effect. The fourth lecture deals with X-rays and their application to crystallography; also with γ-rays and cosmic rays. All the lectures were illustrated by experiments, which are briefly described. A. W.

See also Abstract 2720.

RADIATION, GENERAL THEORY.

2536. Theory of the Photon. K. Nikolsky. *Comptes Rendus de l'Acad. des Sciences, U.S.S.R.* 1. *pp.* 372–377, *Feb.* 21, 1935. *In French.*—The quantum equation of the photon, analogous to the Dirac equations for the electron and positron, is deduced by the introduction of a "supplementary mass" term into the Dirac equation. J. S. G. T.

2537. Electromagnetic Field and Quanta. S. A. de Mayolo. *Comptes Rendus,* 200. *pp.* 1381–1383, *April* 15, 1935.—Further consequences are given of a theory of the electromagnetic field based on the hypothesis that the latter is due to central forces between two noncorpuscular quantities of electricity, equal and of opposite sign, which are coupled together and move with the velocity of light. G. C. McV.

2538. Annihilation Radiation of Positrons. H. A. Bethe. *Roy. Soc., Proc.* 150*A*. *pp.* 129–141, *May* 1, 1935.—The annihilation probability, cross-section, intensity distribution, and frequency of the radiation emitted in the annihilation of positrons are investigated mathematically. A fast positron has a fairly high probability of annihilation during its motion, with emission usually of two quanta, or possibly of one quantum for higher nuclear charge. The respective probabilities for positrons of $1 \cdot 5 \times 10^6$ volt energy are $7 \cdot 5$ and $1 \cdot 5$. In the two-quanta process, usually one quantum takes up almost all the energy of the positron, the other having an energy of the order mc^2. The hard annihilation radiation is practically isotropic if emitted in substances of high atomic weight, and is believed to be identical with the hard component in the "scattered γ-rays" found by several authors. Experimental results on the energy and intensity of this hard component differ widely, probably on account of the erroneous assumption that it is homogeneous in frequency. The "scattered" radiation is considered to consist of a broad band of all frequencies from $\frac{1}{2}\, mc^2$ up to the frequency of the incident γ-rays, with the addition of the Compton scattering and the mc^2 component. N. M. B.

See also Abstract 2524.

RADIATION, MECHANICAL EFFECTS.

2539. Energy and Angular Momentum in Optical Problems. R. d'E. Atkinson. *Phys. Rev.* 47. *pp.* 623–627, *April* 15, 1935.—An experimental proof of the theory that circularly-polarised light possesses angular momentum is reviewed, and a simplified modification is described. The experiment involved moving interference fringes, and a general condition, necessary but not sufficient, for obtaining such fringes is enunciated. Its application to five other optical problems is discussed. It is found: (*a*) that moving interference fringes should be obtainable from an arrangement with two diffraction gratings; (*b*) that if polarised light is reflected obliquely from a metal mirror revolving in its own plane, the absorption by the metal should vary by an amount proportional to the speed of rotation; (*c*) in two other cases support is found for the view that all photons possess the same amount of angular momentum, the state of polarisation of the light depending on their statistical arrangement. AUTHOR.

REFLECTION. REFRACTION AND DISPERSION.

2540. Spherically-Symmetric Systems. H. Boegehold and M. Herzberger. *Zeits. f. angew Math. u. Mechanik,* 15. *pp.* 157–178, *April,* 1935.—Optical systems exhibiting rotation symmetry about any line through a fixed point (spherically symmetric systems) are studied in detail. The centre point is sharply imaged on itself but the sharp imaging of any other point occurs only if the system is a " space imaging system " (for which every point of space is sharply imaged) or a " two sphere imaging system " (for which two spheres with the same centre are sharply imaged). For the special case of concentric systems in which all the surfaces are concentric spheres, all the space imaging and two sphere imaging systems employing 4 and 3 surfaces respectively, are specified. Some results due to Bauersfeld concerning spherically symmetric systems employing reflecting spheres and non-homogeneous media are also included. W. S. S.

2541. Refractive Index of Rubber. A. T. McPherson and A. D. Cummings. *Bureau of Standards, J. of Research,* 14. *pp.* 553–562, *May,* 1935.—The refractive index of rubber was measured on an Abbe refractometer by a method of total reflection. For plantation Hevea rubber and purified rubber average values of n_{D}^{25} are 1·5188 and 1·5190, respectively. The index of crude rubber is not altered by the introduction of insoluble fillers. Sulphur in solution increases n_{D}^{25} of crude rubber by 0·0016 for each % and phenyl-β-naphthylamine, by 0·0015 for each %. The refractive index of vulcanised compounds of purified rubber and sulphur is given by $n^t{}_D = 1 \cdot 5190 + 0 \cdot 00370\, \mathrm{S}_c - 0 \cdot 00035\, (t - 25)$, where S_c represents the percentage of combined sulphur, between 0 and 16, and t, the temperature in °C, between 10 and 75° C. The curve relating refractive index to temperature for a compound containing 19 % of S undergoes a change in slope at about 17° C. Preliminary measurements on compounds containing 19 to 32 % of S indicate that the transition from soft to hard rubber is accompanied by a decrease in the slope of the curve relating refractive index to temperature. AUTHORS.

2542. Anomalous Dispersion in Thallium Vapour. G. S. Kwater. *Phys. Zeits. d. Sowjetunion,* 7. 2. *pp.* 226–244, 1935. *In German.*—The ratios of the *f*-values of four thallium lines are determined by measurement of the anomalous dispersion in thallium vapour in the respective spectral regions. The value $f_{3519}/f_{3529} = 9 \cdot 0 \pm 0 \cdot 8$ is obtained, in agreement with Dorgelo's result for the intensity relationship of these lines. The ratio $f_{5350}/f(_{3519} + f_{3529}) = 0 \cdot 37 \pm 0 \cdot 02$. From the dependence on temperature of the ratio $\mathfrak{N}_{3776}/\mathfrak{N}_{5350}$ ($\mathfrak{N}$ = number of classical oscillators with the given frequency), the ratio h/k, Planck constant/Boltzmann constant, is found to be $4 \cdot 43 \times 10^{-11}$ in one series of measurements, and $4 \cdot 67 \times 10^{-11}$ in a second. The ratio of the statistical weights, $g_1/g_2, = 0 \cdot 51$. C. B. A.

***2543. Optics and Mechanics of the Modern Microscope. K. Fischer.** *Zeits. f. Instrumentenk,* 55. *pp.* 145–157, *April,* 1935.—An historical survey is given first of the development of the microscope to allow for spherical and chromatic aberration, distortion of the field, errors in human eyes, use of double tubes, condensor, and iris diaphragms. Modern improvements along these lines by various firms are then considered. These have led to (1) improved focussing of the rays from the apochromat and made possible the use of the strongest eyepiece, thus providing a greater magnification for each objective and limiting the number of objectives, while rendering the instrument portable, and easy to handle and control, and involving no loss of illumination with the condensor; (2) a sharp flat large field of view without special eyepieces or objectives; (3) the improved technique of small photographic plates with fine-grain emulsions, while a small, light, portable camera now gives the same result for 6 × 9 or 9 × 12 where formerly 24 × 30 cm. was required; (4) the use of the modern vapour lamp and setting up the objective for its most favourable region without loss of light; and (5) improvements of the mechanical structure. R. S. R.

See also Abstracts 2354, 2437, 2562, 2599, 2602, 2717, 2756.

SPECTROSCOPY.

2544. Provisional Wave-Length Standards for the Extreme Ultra-Violet. J. C. Boyce and C. A. Rieke. *Phys. Rev.* 47. *pp.* 653–657, *May* 1, 1935.—This paper discusses the criteria for suitable wave-length standards in the extreme ultra-violet, and presents provisional values (obtained with a 2 m. focus normal incidence vacuum spectrograph) for a number of lines of C, N, O and A falling in the spectral range between λ1850 and λ800. These are compared with the previous results of Edlén and of Bowen and of Bowen and Ingram. Further independent determinations are desirable. The present values, as those obtained by previous investigators, may be subject to a small systematic error inherent in the method of overlapping orders. This source of error is believed to be small, but must be eliminated before permanent standards can be established. AUTHORS.

2545. Pure Rotation Spectra of NH_3 and ND_3. R. B. Barnes. *Phys. Rev.* 47. *pp.* 658–661, *May* 1, 1935. The pure rotation spectra of NH_3 and ND_3 have been measured in the spectral region from 40μ to 170μ. Ten rotation lines of NH_3 corresponding to final J values from 3 to 12 have been observed. These fall upon a curve given by $\nu = 19{\cdot}880J - 0{\cdot}00176J^3$. Thirteen lines of ND_3 corresponding to final J's from 8 to 20 have been observed. These fall upon a curve given by $\nu = 10{\cdot}26J - 0{\cdot}00045J^3$. [See Abstract 3316 (1934).] AUTHOR.

2546. Characteristics of Pb I, Pb II, Pb III and Pb IV Lines Revealed in Instantaneous Spectrograms. H. Nagaoka and T. Futagami. *Imp. Acad. Tokyo, Proc.* 11. *pp.* 43–46, *Feb.*, 1935. *In English.*—The spectrum of lead obtained from a disruptive discharge between pointed electrodes is photographed on a rotating drum so that its variation during the discharge may be examined. The lines of Pb I are found to be of two types, one being continuous but showing reversal every half period, whilst the other loses continuity at every half period. Two types also appear in Pb II, and these lines again are only excited at each half period. Pb III is only excited during a small time interval, strongly at first, but fading out, and Pb IV lines only appear as dots at the beginning of every half period. The disruptive discharge is a source of strongly ionised lines from whose appearance the state of ionisation can be directly inferred. C. B. A.

2547. Regularity in the Second Spark Spectrum of Iodine. J. B. Seth. *Indian Acad. Sci., Proc.* 1. *pp.* 593–604, *March*, 1935.—Bloch's values of wave-lengths were used and graphical methods employed to determine frequency differences corresponding to certain transitions from

data applying to neighbouring elements. The observed frequency differences are tabulated and also the designations of the proposed terms. It is hoped that these results will lead to a complete analysis of this spectrum.
F. S.

2548. Perturbed Series, Especially in C III, B I and O IV. N. G. Whitelaw and J. E. Mack. *Phys. Rev.* 47. *pp.* 677–678, *May* 1, 1935.—Consideration of possible extra-configurational perturbations in atomic spectral series shows that often some series are preferable to others for the determination of series limits. In particular: In C III, several $2snd\,^3D$ terms are recalculated, but Edlén's series limit value is verified in spite of perturbations; in B I, the term values are increased by 90 cm^{-1} or 0·011 volt, so that B I $2s^2 2p\,^2P_{\frac{1}{2}}$ − B II $2s^2\,^1S_0 = 66{,}930\ \text{cm.}^{-1} = 8{\cdot}257$ volts; and in O IV, the old $5s\,^2S_{\frac{1}{2}}$ term is replaced by a new one at 85,440 cm.^{-1}, $?4p\,^2P$ and $?6f\,^2F$ are repudiated, and $?7f\,^2F$ and $?8f\,^2F$ are verified.
AUTHORS.

2549. Isotope Shift in Mg I. R. F. Bacher and R. A. Sawyer. *Phys. Rev.* 47. *pp.* 587–591, *April* 15, 1935.—The lines of the Mg I spectrum, lying in the visible and in the photographic infra-red regions, have been examined and some of them found to show structure. It is pointed out that the structure should be attributed to isotope shift, which, in the case of the $3s3p\,^1P - 3s3d\,^1D$ series, owes its origin to the fact that the $smd\,^1D$ terms, perturbed by the $p^2\,^1D$ term, have passed on to this term some of their isotope separation, which, in the unperturbed case, would have been the same as that of $3s3p\,^1P$ and thus unobservable. This perturbation is discussed in connection with the observed shifts, and it is found possible to correlate the observed shifts with the calculated displacements of the $3smd\,^1D$ energy levels produced by the $p^2\,^1D$ perturbation, with satisfactory agreement. Since the observed patterns show two components, they cannot be attributed to mass effect, which would give three nearly equally spaced components. Furthermore, the shift is in the wrong direction to be accounted for by the usual assumption that heavier isotopes have larger radii, and, consequently, looser binding of electrons than the lighter isotopes.
AUTHORS.

2550. Multiplets and Terms in the Cb I and Cb II Spectra. W. F. Meggers and B. F. Scribner. *Bureau of Standards, J. of Research,* 14. *pp.* 629–648, *May,* 1935.—In the decade which has passed since the first indications of structure in these spectra were found, efforts have been made to improve the fundamental data so that the analyses might be extended. Careful estimates of relative intensities and accurate measurements of wave-lengths have been compiled for about 3000 Cb I lines and 2000 Cb II lines. Results are now reported for the principal multiplets found in each spectrum, they reveal sextet and quartet terms for Cb I, quintet and triplet terms for Cb II, and account for most of the stronger lines. The normal state of neutral Cb atoms is represented by $(4d^4 5s)\,^6\mathrm{D}$ and for singly ionised atoms by $(4d^4)\,^5\mathrm{D}$.
AUTHORS.

2551. Intensity Measurements with a Reflection Echelon. J. H. Gisolf and P. Zeeman. *K. Akad. Amsterdam, Proc.* 38. 3. *pp.* 225–229, 1935.—A method developed by Merton for measuring the relative intensities of neighbouring spectral lines with a transmission echelon grating is applied to the measurement by a reflection echelon of the relative intensities of hyperfine structure components. The echelon is placed in an airtight box fitted with a large quartz window and by changing the pressure of air in the box the directions of the diffraction maxima of lines are changed. The intensities of the diffraction maxima depend in known manner on the diffraction angles and by changing the pressure until two lines have the same intensity the true relative intensity of the lines can be calculated. By this means the intensities of the outer hyperfine structure components of the Cd line 4678 Å are compared using a 25 plate echelon with a 7·05 mm. thickness and 1 mm. step. An intensity ratio of 3 to 1 is measured which compares with the theoretical value of 2 to 1. This ratio is, however, according to Schüler, strongly dependent on the type of light source used. J. E. K.

2552. Centre of Intensity of Groups of Spectral Lines. F. Paschen. *Preuss. Akad. Wiss. Berlin, Ber.* 25. *pp.* 456–465, 1934.—The true wave-length of a line in the fine structure of the spectrum of an element does not in general coincide with the wave-length of any hyperfine structure component of the line but is the wave-length of the centre of gravity or centre of intensity of the array of hyperfine components. Elements which have at least one isotope with zero nuclear moment have hyperfine components coincident with the centre of intensity, but for elements such as indium which have a single nuclear moment the centre of intensity must be calculated from the observed positions and calculated intensities of the hyperfine components. It may happen, however, that the hyperfine structure pattern of a line can be only partially resolved and a theoretical calculation is given in this paper which provides a simple method of deriving the position of the centre of intensity when the nuclear moment and the separation factors and group quantum numbers of the two combining terms of a line are known and the undisturbed position of only one hyperfine component of a group can be observed. The theory is illustrated by the spectrum of In II whose fine structure analysis could only be completed after calculation of centres of intensity of partially resolved hyperfine structure line groups. J. E. K.

2553. Deviations of the Atomic Nucleus from Spherical Symmetry. H. Schüler and T. Schmidt. *Zeits. f. Physik*, 94. 7–8. *pp.* 457–468, *April* 8, 1935.—The hyperfine structures of the Eu I lines 7106, 6865 and 6018 Å are analysed and it is concluded that the mechanical nuclear moments of Eu^{151} and Eu^{153} are both 5/2, the ratio of the magnetic moments $\mu_{151} : \mu_{153}$ being 2·2. It is pointed out that, in the case of elements of odd atomic number which have two isotopes, the two isotopes have the same nuclear spin except in the case of the radioactive element Rb. In the case of Eu there are discovered deviations of the hyperfine structure patterns from the cosine law (Landé interval rule), and it follows that the Eu nucleus does not possess spherical symmetry. Similar asymmetry of the nucleus is shown by Cp, In, Sb and Hg. J. E. K.

2554. Structure of Hydrogen Lines. K. Bechert and J. Meixner. *Ann. d. Physik*, 22. 6. *pp.* 525–536, *April*, 1935.—No difference can arise between the fine structure of H and D within the present limits of exactitude of measurement. The wave-mechanical treatment of the relativistic contribution of the motion of the nucleus gives the Darwin mass correction and the known hyperfine structure which has already been calculated by Fermi from the H atom model with stationary nucleus and a magnetic moment. An experimental proof of the hyperfine structure is impossible until the hyperfine structure can be resolved, since the centre of intensity of the fine structure components is not displaced by the hyperfine structure. J. E. K.

***2555. Hyperfine Structure of the Red Cadmium Line 6438 Å and of Sr, Sn and Mg. H. Westmeyer.** *Zeits. f. Physik*, 94. 9–10. *pp.* 590–596, *April* 16, 1935.—A structure found by Ferchmin and Romanowa for the red Cd-line λ6438 could not be confirmed. The hyperfine structure of the two resonance lines λ4077 and λ4216 of Sr II is investigated with 15, 20 and 22 mm. Fabry-Perot étalons and from the observed structures the nuclear moment is deduced to be $I = -3/2$. The nuclear moment of Sn, $I = -\frac{1}{2}$ previously found from analysis of the Sn II spectrum by Schüler and Westmeyer and Tolansky is confirmed by investigation of the hyperfine structure of a number of Sn I lines. In the Mg I spectrum an isotope displacement is observed in the lines λλ5528, 5711, 4703 and 4571 Å. An apparatus suitable for the silvering of interferometer plates by kathode sputtering is described. J. E. K.

2556. Magnetic Moment of the K^{39} Nucleus. J. J. Gibbons, Jr., and J. H. Bartlett, Jr. *Phys. Rev.* 47. *pp.* 692–694, *May* 1, 1935.—Starting with the K$^+$ field given by Hartree, a 4*s* wave function has been found by numerical integration. The orthogonality correction diminishes the value of the wave function at the origin by about one-third. The experimental value of the hyperfine structure separation of the ^{2}S normal state is 0·015 cm^{-1}. From this is calculated a molecular magnetic moment of 1·2 nuclear magnetons, as compared with the value of 0·38 nuclear magneton calculated by Millman, Fox and Rabi on the basis of the modified Goudsmit's formula. The disagreement seems to be due chiefly to the possibility that the single electron wave functions of Fermi and Segré are not mutually orthogonal. AUTHORS.

2557. Hyperfine Structure Formulæ for the Configuration d^{2}s. M. F. Crawford. *Phys. Rev.* 47. *pp.* 768–777, *May* 15, 1935.—Hyperfine-structure interval-factor formulæ for the states of d^2s are derived by the method of Breit and Wills. The formulæ for intermediate couplings are expressed in two forms: one involving the coefficients C's, the other the coefficients K's, corresponding to the representation of the functions of the states in intermediate coupling as a linear combination of the (*jj*) and the (LS) functions, respectively. The (LS)$\rightleftharpoons$(*jj*) transformation matrices as well as the interval factor formulæ for (LS) and (*jj*) coupling are also given. As the coefficients are determined from the empirical multiplet separations, the energy matrices in both (LS) and (*jj*) coupling are listed. The theory is applied to the $5d^26s\ ^4$F states of La I and consistently accounts for the relative hyperfine structure separations of these states. The values obtained for the interaction constants of the 6*s* and 5*d* electrons are 0·119 and 0·0039 cm^{-1}, respectively. The nuclear *g*-factor computed from these is $g(\mathrm{I}) = 0{\cdot}71$. The corresponding value of the nuclear magnetic moment is 2·5 nuclear magnetrons. AUTHOR.

2558. Electronic Excitation-Function of the Metastable S$_5$-Level of Neon. J. M. W. Milatz and L. S. Ornstein. *Physica*, 2. *pp.* 355–362, *April*, 1935. *In English.*—By means of an absorption measurement the excitation-function of the metastable s_5-level of neon is determined. It is shown that the measurement probably gives the electrical excitation-function. AUTHORS.

2559. Calculation of Optical Terms with the Aid of Fermi's Statistical Potential. E. Hellmig. *Zeits. f. Physik*, 94. 5–6. *pp.* 361–368, *April* 2, 1935.—The Rydberg corrections of the arc spectrum for the *s*-, *p*-, *d*- and *f*-terms are calculated. From these, curves for the spark spectrum are obtained by considerations of analogy. The theory is in good agreement with experiment. C. B. A.

2560. Schuster Bands of Ammonia. R. W. Lunt, J. E. Mills and E. C. W. Smith. *Faraday Soc., Trans.* 31. *pp.* 792–797, *May*, 1935.—It has been shown that the molecule responsible for the Schuster bands contains nitrogen and hydrogen only. It has been suggested that the synthesis of hydrazine in discharges occurs at collisions between ammonia and the singlet states of NH molecules. This suggestion affords a possible mechanism for the emission of the Schuster bands, and is in accordance with the known chemical and physical data connected with the appearance of the band and the synthesis of the hydrazine. AUTHORS.

2561. Ultra-Violet Bands of Helium. J. L. Nickerson. *Phys. Rev.* 47. *pp.* 707–711, *May* 15, 1935.—The band at λ600 in the extreme ultra-violet spectrum of helium, first observed by Lyman and first attributed to the helium molecule He_2 by Sommer, has been investigated under various discharge conditions. Low voltage arc, Schüler hollow kathode and uncondensed capillary discharges have been used as sources with a 1 m. vacuum spectrograph. The helium used was circulated from the spectrograph back to the discharge tube through the purifying system of a misch metal arc and a chabazite trap in liquid air. The band at λ600 appeared under those conditions of purity which favoured the appearance of the visible bands of helium and under such conditions that there can be little doubt that it is due to helium. The intensity of this λ600 band varied directly with the first power of the current in the discharge, whereas the visible bands are known to vary as the square of the current. This suggests a difference of mechanism in the two cases, and in the light of this, various explanations of the origin of the λ600 band are considered but none found satisfactory. A possible explanation of the diffuse structures appearing at λ647 and λ662 is advanced. AUTHOR.

2562. Residual-Ray Bands of LiF and MgO. K. Korth. *Göttingen Nachrichten, Fachgruppe II.* 1. 15. *pp.* 187–194, 1935.—Measurements of the residual rays of LiF and MgO indicate a difference between the eigenfrequencies of the ions in the interior of the crystal and those situated in the surface, the corresponding maxima of reflection and minima of transmission being recognisable in the respective spectra. The minimum of transmission for the surface molecules, observed in crystal powder, is considerably less than that for the internal molecules. C. B. A.

2563. Optical Investigations of Aldehyde-Alcohol Systems in Indifferent Solvents. O. Grabowsky and W. Herold. *Zeits. f. phys. Chem.* 28. *Abt.* B. 4. *pp.* 290–302, 1935.—Absorption spectrum measurements of alcohol-aldehyde mixtures in cyclohexane, hexane, CCl_4, cyclohexene, chloroform, dioxan, diethyl ether and ethyl propionate are used to discuss the reaction mechanism of the formation of the compound (half acetal) formed by the union of one molecule of the alcohol with one molecule of the aldehyde. The influence of intermolecular forces, *e.g.* solvation and association, and of solvent, temperature and reacting compounds are discussed. An unstable addition compound (1 half-acetal + 1 alcohol) at low temperatures was detected. W. R. A.

2564. Ultra-Violet Absorption Spectra of Derivatives of Diphenylene Sulphide and Diphenylene Sulphone. M. Chaix. *Comptes Rendus*, 200. *pp.* 1208–1210, *April* 1, 1935.—Absorption spectra of halogen and nitro-derivatives (at 3 or 3 : 6) of diphenylene sulphide, and of halogen derivatives (at 2 or 2 : 7 ; 3 or 3 : 6) of diphenylene sulphone in ethyl alcohol solution have been examined. Monosubstitution of Cl or Br in diphenylene sulphide produces little change in the absorption spectrum. Di-substitution displaces the spectrum by about 100 Å towards longer wave-lengths. The substitution of the nitro-group gives rise to a profound change, the bands of the original substance no longer being observed. In the case of diphenylene sulphone, bands at 3250, 2900, and 2820 Å become less sharp on substitution of one or two halogen atoms at 3 or 3 : 6. The band at 2430 Å, however, continues very strong, but displaced by definite intervals. Substitution at 2 or at 2 : 7 produces only a displacement of all the bands towards the red, with increased intensity. The 2 : 7 derivatives are more coloured than the 1 : 3 derivatives. The absorption spectrum can thus be used for identifying the configurations of the substituted compounds. No absorption curves are reproduced in this paper. C. B. A.

2565. Far Ultra-Violet Absorption Spectra of Formaldehyde and the Alkyl Derivatives of H_2O and H_2S. W. C. Price. *J. Chem. Phys.* 3. *pp.* 256–259, *May*, 1935.—The absorption spectra of formaldehyde and of compounds of the type HOH, ROH, ROR and HSH, RSH, RSR have been observed in the region 2300–1000 Å. An analysis of the spectrum of formaldehyde yields a value of $10 \cdot 83 \pm 0 \cdot 01$ volts for the first ionisation potential of the $C = O$ bond and about 164 Cal./mole for the strength of this bond. The spectra of the alkyl derivatives of H_2S are all shown to be shifted to the long wave-length region relative to those of H_2O. Rough estimates of their ionisation potentials are given and the influence of dipole moment on the ultra-violet absorption spectra and ionisation potentials of polyatomic molecules is discussed. AUTHOR.

2566. New Diatomic Band Spectra. H. G. Howell and G. D. Rochester. *Univ. Durham Phil. Soc., Proc.* 9. *pp.* 126–134, *Dec.*, 1934.—A preliminary account is given of the production of hitherto unknown band spectra of a large number of diatomic molecules by methods applicable to substances which have inappreciable vapour pressures at ordinary temperatures. The observed spectra, some of which are briefly described, are in three groups: (I) Absorption spectra of substances vaporised at high temperatures (up to 1400° C.) in vitreosil tubes in a silit furnace, *e.g.* PbO, PbS, PbSe, PbTe, SnS, SnSe, SnTe, and sulphides of Cu, Ag, Ni and Fe. (II) Emission spectra developed in arc flames, *e.g.* FeO, NiO, CoO, CuO, WO, TeO, PtO, CeO and ThO. (III) Emission spectra produced in the high-frequency discharge in externally heated tubes, *e.g.* PbF, PbBr, BiF, BiBr, SnBr, SnI and FeF. For PbS five band systems involving the ground state (X) have been recognised and formulated, the constants for the six electronic levels being (in $cm.^{-1}$):

Level	X	A	B	C	D	E
ν_e	0	18851·3	21847·7	23212·9	25024·4	29650·5
ω_e	428·14	261·09	282·17	303·93	283·95	299·34
$x_e\omega_e$	1·201	0·365	0·856	1·436	1·171	1·574

W. J.

2567. Perturbations in $^2\Sigma \rightarrow {}^2\Sigma$ Bands of N_2^+. H. H. Brons. *K. Akad. Amsterdam, Proc.* 38. 3. *pp.* 271–280, 1935.—The 5, 7 and 3, 5 bands of the $B\,{}^2\Sigma \rightarrow X\,{}^2\Sigma$ system of N_2^+ are re-measured and analysed, the band-origins being given as 22305·0 and 21971·5 $cm.^{-1}$ respectively, and the B_v values for the upper and lower levels as $B'_3 = 2 \cdot 000$, $B'_5 = 1 \cdot 952$, $B''_5 = 1 \cdot 827$, $B''_7 = 1 \cdot 777$ $cm.^{-1}$. The perturbations (displacements and splittings of lines) observed in these bands are fully described and interpreted. Like those already investigated in the 9, 8 and other bands of the system [see Abstract 3734 (1934)], they are traced to rotational levels of the B $^2\Sigma$ state and are caused by a neighbouring inverted $^2\Pi$ state. The B $^2\Sigma$ levels where the perturbations reach maximum values, *i.e.* where energy curves of $^2\Sigma$ and $^2\Pi$ intersect, are $K = 2$, $J = 1\frac{1}{2}$ and $K = 6$, $J = 6\frac{1}{2}$ for $v' = 5$, and $K = 5$, $J = 4\frac{1}{2}$ and $K = 10$, $J = 10\frac{1}{2}$ for $v' = 3$. All these are intersections with $^2\Pi_{1\frac{1}{2}}$, the corresponding intersections with $^2\Pi_{\frac{1}{2}}$ being at higher J-values which are beyond the observations of the two bands. This interpretation is in accordance with Ittmann's theory of perturbations and corrects the results of an earlier analysis of the 3, 5 band [see Abstract 2425 (1932)]. The perturbations observed in the 1, 2 and 1, 3 bands are now attributed to an intersection of the $v' = 1$ curve at $K = 14$, $J = 13\frac{1}{2}$ by $^2\Pi_{1\frac{1}{2}}$ and not by $^2\Pi_{\frac{1}{2}}$ as previously stated. W. J.

2568. Band Spectrum of Cadmium. T. S. Subbaraya. *Indian Acad. Sci., Proc.* 1*A*. *pp*. 484–488, *Feb.*, 1935.—The author gave an account of an analysis of the band spectrum of Hg [see Abstract 5053 (1934)] which showed a peculiarity in the terms belonging to the ground state. The bands of Cd are now examined, to see what light this throws on the earlier problem. It is found that the same peculiarity occurs in the ground state terms of the Cd bands. A. C. M.

2569. Rotational Analysis of Band Spectrum of Zirconium Oxide. F. Lowater. *Roy. Soc., Phil. Trans.* 234*A*. *pp*. 355–376, *June* 7, 1935.—Bands, 1, 0 ; 0, 0 ; and 0, 1 of system α of the spectrum of molecule $Zr^{90}O$ and its isotope of next abundance $Zr^{94}O$ have been analysed. The 0, 0 band consists of R, R^i, P and P^i branches in each of the substates $^3\Pi_0$ $^3\Pi_1$ and $^3\Pi_2$, the presence of possible Q and Q^i branches in substate $^3\Pi_2$ being indecisive. The 0, 1 band has the same R, R^i, P and P^i branches as the 0, 0 band ; it has also Q and Q^i branches in substate $^3\Pi_2$. The 1, 0 band has been analysed into R, R^i, P and P^i branches in each of the substates $^3\Pi_0$ and $^3\Pi_1$, but the analysis in the substate $^3\Pi_2$ has not been accomplished. In none of the bands has Λ-type doubling been found. The origins of the bands could not be observed directly on account of the crowding together of lines in their proximity. For the upper and lower $^3\Pi$ states respectively the mean values of B_0 are 0·5256 and 0·6158, of α about 0·009 and 0·007 cm^{-1} and of r_e $1{\cdot}521 \times 10^{-8}$ and $1{\cdot}413 \times 10^{-8}$ cm. [See Abstract 1979 (1932).] AUTHOR.

2570. Emission Spectrum of Diatomic Arsenic. G. M. Almy and G. D. Kinzer. *Phys. Rev.* 47. *pp*. 721–730, *May* 15, 1935.—The emission spectrum of As_2 consists principally of an extensive group of bands in the ultra-violet, which have been analysed into two overlapping band systems. These two systems have the same lower state. Their upper states lie at about the same electronic energy, have similar vibrational intervals and perturb one another strongly. In one system, called A → X, predissociation sets in at two points in the upper state, namely, at $v' = 9$ and $v' = 14$. In the regions where predissociation is occurring absorption bands appear (for low v'') on the emission plates. The heat of dissociation obtained depends upon what assumption is made as to the pair of atomic states standing at the predissociation energy. If this pair is $^4S + {}^2D$, D(X) is about 4·0 volts in agreement with the value obtained by extrapolation of the vibrational levels, but if this pair is $^2D + {}^2D$, as appears to be required by the Kronig rules for perturbations and predissociations, D(X) is 2·6 volts. AUTHORS.

2571. Infra-Red Spectrum and Molecular Constants of Hydrogen Iodide. A. H. and H. H. Nielsen. *Phys. Rev.* 47. *pp.* 585–586, *April* 15, 1935.—The fundamental and first overtone bands of HI have been measured under high resolution and the lines in the positive and negative branches in both bands have respectively been fitted to formulæ of the form : $\nu = a + bm + cm^2 + dm^3$. The molecular constants ν_0, I_0, B and C as defined by Colby depend directly upon the constants *a, b, c, d* and have been determined from these measurements, their values being $\nu_0 = 2309 \cdot 58$ cm.$^{-1}$, $I_0 = 4 \cdot 221 \times 10^{-40}$ gm. cm.^{2}, $B = 0 \cdot 822 \times 10^{-5}$, $C = 6 \cdot 058$. AUTHORS.

2572. Infra-Red Spectra, Normal Vibrations, and Intramolecular Forces in SeF_6 and TeF_6. H. Sachsse and E. Bartholomé. *Zeits. f. phys. Chem.* 28. *Abt.B.* 4. *pp.* 257–266, 1935.—From measurements of the infra-red bands between 3μ and 25μ and unpublished data on the specific heats, the normal vibrations of the molecules are derived. The seven force constants are evaluated. There is a striking difference between these two fluorides and SF_6. In these there is an alternation effect between neighbouring atoms which introduces angular forces ; in SF_6 no such effect is encountered. The heats of binding are calculated. W. R. A.

2573. Fundamental Frequencies of a Plane Symmetrical Hexagonal Molecule of Type X_6. C. Manneback. *Ann. Soc. Sci. de Bruxelles*, 55. *pp.* 5–15, *March* 30, 1935.—Mathematical. A completion and simplification of an earlier memoir. [See Abstract 1158 (1935).] W. R. A.

2574. General Relation Between Vibration Frequencies of "Isotopic" Molecules. Calculation of Harmonic Force-Constants. O. Redlich. *Zeits. f. phys. Chem.* 28. *Abt.B.* 5. *pp.* 371–382, 1935.—The frequencies of one and the same vibrational type of two molecules which differ from one another only in the mass of one or more atoms (such molecules being referred to as isotopic molecules) are connected by a relation in which appear only the atomic masses and moments of inertia and not the force constants. In the deduction of the formula the only presumptions are the harmonic character of the vibrations and the equivalence of the force constants for isotopic molecules. The determinants which connect the vibration frequencies with the harmonic force constants are brought into a form which is suitable as a starting point for the calculation of special cases. The deduced relation is tested by application to the vibration frequencies of deutoro-chloroform. J. E. K.

2575. Lifetime of Free Hydroxyl. O. Oldenberg. *J. Chem. Phys.* 3. *pp.* 266–275, *May*, 1935.—(1) The reasons for various failures to observe the absorption spectrum of free hydroxyl radicals are discussed. (2) The absorption spectrum of OH in the electric discharge through water vapour is observed with a spectrograph of high resolving power. After interrupting the discharge, the presence of OH is traced by its absorption spectrum over time intervals up to 1/8 sec. (3) With alternating half-periods of 60 cycle a.c. cut out by a switch, the emission of OH vanishes almost entirely with the current whereas the absorption persists rather uniformly. It is concluded that the persistence of the absorption spectrum is to be attributed to a long life of OH radicals rather than a long life of O and H atoms furnishing a fresh supply of short life OH radicals. (4) The rotational intensity distribution within the OH band at strong currents (being anomalous to a lesser extent than at faint currents) indicates the presence of free OH in the discharge. (5) For a comparison of the present result with previous estimates, leading to a much shorter life of free hydroxyl, the number per sec. of emission processes of the OH band is measured, assuming that each of these processes leads to the production of one free OH radical. (6) The process by which OH radicals are consumed is discussed. AUTHOR.

2576. Statistical Weights of the Rotational Levels of Polyatomic Molecules. E. B. Wilson, Jr. *J. Chem. Phys.* 3. *pp.* 276–284, *May,* 1935.—A general method is described for calculating the statistical weights (degeneracies) of the energy levels of polyatomic molecules. Wave functions for a molecule are assumed to be expressible as linear combinations of products of the electronic, vibrational, rotational and nuclear spin functions. By using standard methods of group theory, the number of linear combinations of these products is found having the correct symmetry with respect to those permutations of identical atoms which are equivalent to rotations of the molecule. It is not necessary to find the combinations themselves. The molecules CH_4, CD_4, CH_3D, CHD_3, CH_2D_2 CH_3X, CD_3X, NH_3, ND_3, C_6H_6, C_3H_6 and C_2H_4 are treated. In addition non-combining species in polyatomic molecules and the splitting of energy levels due to the multiplicity of equilibrium configurations are discussed. Tables of statistical weights are given for the above molecules which could be used to interpret alternating intensities in rotation-vibration spectra or for more exact calculations of thermodynamic quantities than are usually made. AUTHOR.

2577. Isotopic Shifts in the Spectra of Diatomic Molecules. G. H. Dieke. *Phys. Rev.* 47. *pp.* 661–665, *May* 1, 1935.—An inspection of the theory of diatomic molecules shows that the elementary theory of the dependence of the energy of diatomic molecules on the mass of the nuclei must be supplemented in two ways. In the first place the reaction of the nuclei to the precession of the electronic angular momentum about the internuclear axis gives a term $[B_e - \alpha(V + \frac{1}{2})][L(L + 1) - \Lambda^2]$. Furthermore there is a second positive term of uncertain magnitude. Both these terms are of importance only for very light molecules especially for the hydrogen molecule. The large electronic shifts observed for some band systems of H_2, HD and D_2 are well accounted for by this theory. A very accurate comparison of the constants of very light isotopic molecules necessitates also taking into account small corrections which appear in the higher order approximations of the energy values for a rotating anharmonic oscillator. AUTHOR.

2578. Internuclear Distance and Vibration Frequency in Diatomic Molecules. H. S. Allen and A. K. Longair. *Phil. Mag.* 19. *pp.* 1032–1041, *May,* 1935.—A formula $\omega_e r_e^3 \sqrt{\mu} =$ const. is suggested for the relationship between the internuclear distance r_e and vibration frequency ω_e for diatomic molecules ($\mu =$ reduced mass). This formula is compared with those proposed by Morse and by D. Clark. Unlike these, it will fit in with isotope theory. The constant varies for the molecular periods, and for most non-hydride molecules is proportional to the number of completed shells. The average value for the KK period (each atom having a completed K-shell) is $10 \cdot 602 \times 10^{-33}$ gm$^{\frac{1}{2}}$ cm^2. C. B. A.

2579. Continuous Absorption Spectra of Polyatomic Molecules. Part V. Y. Hukumoto. *Tôhoku Univ., Sci. Reports,* 23. *pp.* 846–851, *March,* 1935. *In English.*—Results are given of a further investigation of the continuous absorption spectra of a series of alcohols beginning with methyl alcohol (CH_3OH) and ending with dodecyl alcohol ($C_{12}H_{25}OH$).

Some remarks are also made on the relationship between the dissociation energy of the bond and the structure of the molecule. [For Part IV see Abstract 2522 (1934).] AUTHOR.

2580. Absorption Continua of the Alkali Atoms. A. Thoma. *Zeits. f. Physik*, 94. 9–10. *pp.* 621–648, *April* 16, 1935.—A wave-mechanical derivation of the continuous absorption coefficients of the alkali atoms. The eigenfunctions of the discrete states are determined by Hartree's "self-consistent field" method and those of the continua are taken as for H. The calculated values of the absorption coefficients for several wave-numbers (1, 6, 12, 18 and 24 times the basic ^2S term, *i.e.*, the limit of the principal series) and for several temperatures (from 6000° to 10,000°K.) are tabulated for each atom. They decrease as ν increases and as temperature decreases, and tend to constancy for high ν (small λ). The possible sources of error of the derivation are discussed. W. J.

2581. Absorption of Light (5040–5320 Å) by Chlorine. F. W. Jones and W. Spooner. *Faraday Soc., Trans.* 31. *pp.* 811–813, *May*, 1935.—The absorption coefficient of Cl_2 has been measured at a number of wave-lengths where there appears to be no band line absorption, between 5040 and 5320 Å. It is found that a measurable absorption occurs at these points. This absorption appears continuous when the spectrum is examined in the first order of a 10-foot grating; it is, however, possible that greater resolution would show that it is due to a number of close lines. AUTHORS.

2582. Zeeman Effect of the Perturbations of the $A^1\Pi$ State of CO. R. Schmid and L. Gerö. *Zeits. f. Physik*, 94. 5–6. *pp.* 386–396, *April* 2, 1935.—Observations upon the effect of a magnetic field on the perturbed lines of the Ångstrom and Herzberg bands of CO are discussed in the light of a treatment of the various perturbations of the $A^1\Pi$ state. With the object of characterising the perturbing terms, data relative to them are calculated from the positions of the perturbed lines. L. A. W.

2583. Zeeman Effect in Diatomic Molecular States Having L-Uncoupling. J. K. Knipp. *Phys. Rev.* 47. *pp.* 672–677, *May* 1, 1935.—A theoretical investigation is given of the Zeeman effect in molecular states intermediate between Hund's case b' and case d', which are the limiting cases for small and large L-uncoupling, respectively. Zeeman patterns for the 3d and 4d complexes of the helium molecule are calculated and curves obtained for the variation of overall widths with K which are compared with experiment. For small K the energies are near the case b' curves, but as K increases a breaking away occurs which results in their approaching the case d' curves. When the state in the limiting case d' has the electronic angular momentum quantised antiparallel to the nuclear rotation, a crossing over of the magnetic energy curves takes place with the passage through a state in which the molecule is relatively insensitive to the field. This crossing over occurs between K equal to 4 and 8 for the Δ states of the helium molecule considered (magnetic field 30,000 gauss). A crossing over which occurs in one of the Π states is discussed. AUTHOR.

2584. Rotational Raman Scattering in Benzene Vapour. S. C. Sirkar. *Indian Journ. Phys.* 9. *pp.* 295–298, *March*, 1935.—The rotational Raman spectrum of benzene vapour has been successfully recorded with the help of a spectrograph producing lines which are absolutely free from coma on the Stokes side in the region of λ4046. It has been found that in the case of benzene vapour at 210° C and under a pressure of 16·6 atmospheres, the rotational wing is detached from the Rayleigh line, and that starting with zero intensity at about 7 cm.$^{-1}$ from the centre of the Rayleigh line, the wing has a maximum intensity at a distance of about 26 cm.$^{-1}$ from the said point and extends up to about 70 cm.$^{-1}$ from the Rayleigh line. These observed facts are in fair agreement with the theory. AUTHOR.

2585. Raman Spectra of Dimethyl and Diethyl Trisulphides. N. G. Pai. *Indian Journ. Phys.* 9. *pp.* 231–238, *March,* 1935.—The results of a study of the Raman spectra of certain organic trisulphides are discussed in relation to the structure of the molecules. AUTHOR.

2586. Transition of Vibration Spectra from XY_4 to XZ_4. K. W. F. Kohlrausch. *Zeits. f. phys. Chem.* 28. *Abt.B.* 5. *pp.* 340–350, 1935.—The transitions of the Raman effect vibrational states through the sequence $XY_4 \rightarrow ZXY_3 \rightarrow Z_2XY_2 \rightarrow Z_3XY \rightarrow Z_4X$ are deduced and are illustrated by means of the observed spectral transitions $CCl_4 \rightarrow C(CH_3)_4$, $CCl_4 \rightarrow CH_4$ and $CBr_4 \rightarrow CH_4$. J. E. K.

2587. Raman Spectra of Diacetylene and Vinyl Acetylene. B. Timm and R. Mecke. *Zeits. f. Physik,* 94. 1–2. *pp.* 1–10, *March* 12, 1935.—The Raman spectrum of diacetylene was observed at — 10° C. The frequencies (cm.$^{-1}$) observed were 231, 411, 488, 644, 2183 (strong). Vinylacetylene gave at —12°C. 625, 1285, 1397, 1599, 2098 (strong) 3010, 3096, 3300. These frequencies are related to the normal vibrations to be expected for such molecules. A. C. M.

2588. Raman Effect in Mixtures of Nitric and Sulphuric Acids. J. Chédin. *Comptes Rendus,* 200. *pp.* 1397–1398, *April* 15, 1935. Reasons are given for attributing the line 1400 cm.$^{-1}$ scattered by mixtures of nitric and sulphuric acids [see Abstract 1168 (1935)] to a vibration of N_2O_5. A. C. M.

2589. Raman Spectrum of Sulphuric Acid. R. M. Bell and M. A. Jeppesen. *J. Chem. Phys.* 3. *pp.* 245–247, *May,* 1935.—A study was made of the Raman spectrum of sulphuric acid at concentrations varying every five per cent from 100 to 5 per cent by volume. A dispersion of 10 Å/mm. at 4200 Å and 15 Å/mm. at 4500 Å was used. Eight lines were found, which varied gradually in frequency, width, and intensity with changing concentration. Their frequency ranges are 408–432, 561–596, 913–895, 970–973, 980–983, 1031–1051, 1142–1174, 1216–1236, 1332–1352. A gradual change in frequency with concentration was found for a number of the lines. The measurements were checked with a microphotometer. AUTHORS.

2590. Raman Spectra of Molecules of Pentatomic Type. D. H. Rank and E. R. Bordner. *J. Chem. Phys.* 3. *pp.* 248–251, *May,* 1935. —Raman spectra of a number of organic compounds containing a neopentyl group have been obtained. Among these is tetramethylmethane-d_1. The spectrum of this compound shows the various types of isotope effects to be expected for a polyatomic molecule. It is also apparent from the spectrum that the vibrations of tetramethylmethane-d_1 are less degenerate than the vibrations of tetramethylmethane. The spectrum of tetramethylsilicon has 5 lines in the internal vibration spectrum. The explanation for the existence of this extra line is probably the same as that given by Fermi in the case of CCl_4. AUTHORS.

2591. Dependence of Intensity of Raman Lines on Exciting Frequency. L. S. Ornstein and J. J. Went. *Physica,* 2. *pp.* 391–398, *April,* 1935. *In French.*—The relation between the intensities of the

Raman lines and the frequency of the line exciting them has been investigated for quartz and for calcite. The intensities of the lines in quartz satisfy the well-known fourth-power law. In calcite, the intensities grow at a faster rate than the fourth power law would allow as the violet is approached. It is shown that this can be explained by the existence of an absorption at 1600 Å. A. C. M.

2592. Raman Effect for Oxalic Acid in Different States. C. S. S. Rao. *Zeits. f. Physik*, 94. 7–8. *pp.* 536–543, *April* 8, 1935.—For crystalline oxalic acid, the Raman frequencies found were 473, 851, 1506, 1640 and 1758 cm.$^{-1}$, and for oxalic acid in solution, 248 (?), 480, 673 (?), 845, 1430, 1656, and 1744 cm.$^{-1}$, the crystal lines being generally sharper than those given by the dissolved acid. The lines 480, 673 and 850 cm.$^{-1}$ are associated with vibrations of the two COOH groups with respect to each other, while vibrations within these groups are believed to account for the lines 1430, 1650 and 1750 cm.$^{-1}$. Both 1650 and 1750 are attributed to the carbonyl ($C = O$) bond and it is concluded that this must be in a different relation to the other atoms in the two (COOH) groups of oxalic acid. The frequency 1430 is attributed to the OH group. W. S. S.

***2593. Instruments for Measuring Spectral Absorption. W. J. H. Moll, H. C. Burger and W. J. Reichert.** *Journ. Sci. Instruments*, 12. *pp.* 148–152, *May*, 1935.—A method of measuring spectral absorption is described whereby all data may be obtained from a single photographic exposure. For this purpose the normal spectrograph slit is replaced by a device containing seven separate slits, two of these are identical and the remaining five have widths of known fractions of this amount. Details are given of two optical systems by which identical light beams may be passed through two cells containing solution and solvent and subsequently through this special slit. The densities of the seven spectra thus obtained are compared at any desired wave-length by means of a microphotometer. A graphical method is suggested for calculating absorption coefficients from the results thus obtained. AUTHORS.

2594. Quantitative Spectral Analysis. Part III. R. Breckpot and A. Mevis. *Ann. Soc. Sci. de Bruxelles*, 55. *pp.* 16–30, *March* 30, 1935.—A continuation of earlier work [for Part II see Abstract 3318 (1934).] The determination of small amounts of Li, Na, K, Sr, B, Si, P, Te, and Tl in copper oxide is described. *Raies ultimes* are tabulated and their interpretation described. The choice of plate for accurate quantitative work is discussed. W. R. A.

2595. Illumination of the Spectrograph in Quantitative Spectral Analysis. R. Breckpot and L. Lialine. *Ann. Soc. Sci. de Bruxelles*, 55. *pp.* 30–42, *March* 30, 1935.—Errors in photometric work due to incorrect illumination are fully discussed and the various aberrations described. The main methods of focusing the arc on the slit are criticised. W. R. A.

2596. Spectral Analysis of Rare-Gas-Hg Discharge Tubes. H. Schober. *Zeits. f. techn. Physik*, 16. 3. *pp.* 67–73, 1935.—The spectrum of discharge tubes containing Hg-vapour or some other gas easily excited by the usual 50-cycle supply from a transformer, is due almost entirely to the radiation from that gas, so that the spectrum is useless for the indication of the presence of impurities. Cooling the tube to about − 60° C. did not have the hoped-for effect of suppressing the Hg spectrum, but in the course of the experiments a number of interesting colour changes with temperature change were observed and studied. The domination of the Hg spectrum disappeared when the tube was excited, using external electrodes, by a short-wave oscillator (wave-length a few metres) or by the long waves from a spark oscillator; an analysis of the filling was then possible. D. H. F.

***2597. Arrangement for Quantitative Spectrographic Analysis. H. Triché.** *Comptes Rendus*, 200. *pp.* 1538–1541, *April* 29, 1935.—In order to compare two alloys of the same metal, a spark is formed between an electrode of each alloy and a plate of the pure metal interposed to give two sparks of the same length. An image of the double spark so formed can be thrown upon the slit of a spectrograph by means of a lens, before the halves of which are placed variable diaphragms to equalise intensity of selected lines. In an alternative arrangement, the metal plate is prolonged as far as the slit and the lens dispensed with. A rotating sector is then used to equalise intensity. The method resembles Barratt's in some respects. F. S.

See also Abstracts 2325, 2337, 2402, 2435, 2507, 2542, 2639, 2640, 2648, 2649, 2650, 2658, 2682, 2683, 2687.

VELOCITY OF LIGHT.

2598. Velocity of Light Calculated from Radial Velocities of Stars. P. Salet. *Comptes Rendus*, 200. *pp.* 1014–1015, *March* 18, 1935.—Stars of various spectral types were observed in order to test the accuracy of the Lick Catalogue as far as dependence on the azimuth at which a star is observed goes. No error was found. Hence there is a real deviation in the value of the velocity of light deduced from the radial velocities of stars from that found by the Michelson method. G. C. McV.

2599. Experimental Research on Optical Dissymmetry in Space. E. Esclangon. *Comptes Rendus*, 200. *pp.* 1165–1168, *April* 1, 1935.—The author describes and illustrates with a diagram the optical arrangements employed by which observations were made 3-hourly at 10-day intervals over a period of 18 months. The light beam undergoes three reflections and different directions are employed. With the precautions adopted the mean error in measuring the position of the image does not exceed 0·001 sec. of arc. The mean results are tabulated. Terrestrial sources of light have been used and also observations made on stars. The observations indicate that the speed of light with stars is not uniform and identical with that for terrestrial sources of light. For a horizontal ray normally reflected there is no displacement horizontally relative to the reflected ray, when the apparatus rotates horizontally, at least up to 0·001 sec. of arc. Further researches are indicated. R. S. R.

VISION.

2600. Distribution of Colours in Spectrum. H. P. J. Verbeek and M. L. Bazen. *Physica*, 2. *pp.* 380–382, *April*, 1935. *In English.*—A hundred observers with normal colour vision were asked to name the colour of a range of narrow bands distributed through the spectrum. The band widths varied from 6mμ in the blue to 19mμ in the red. The only colour names permitted were red, orange, yellow, green, blue. The limits of the regions corresponding to these colours (as shown by the average opinion) were roughly: red—605mμ—orange—587mμ—yellow—569mμ green—496mμ—blue. J. W. T. W.

2601. Measurement of Amplitude of Accommodation. E. Haas. *Comptes Rendus*, 200. *pp.* 965–967, *March* 11, 1935.—Draws attention to certain corrections necessary in determining the amplitude of accommodation of ametropes, which are not generally allowed for in the usual methods of measurement. W. S. S.

2602. Distribution of Light in the Retinal Image of a Distant Point. C. Lapicque. *Comptes Rendus*, 200. *pp*. 1098–1100, *March* 25, 1935.—The distribution of total luminosity in the retinal image of a point source emitting white light (equi-energy spectrum with respect to wave-length) was computed assuming the eye to be accommodated in turn for light of different wave-lengths throughout the spectrum. Chromatic aberration and diffraction were allowed for. The accommodation wave-length giving the " sharpest " retinal image was found to equal 580$m\mu$. A further calculation shows the effect on the distribution of spherical aberration. A pupil diameter of 4mm. was assumed. W. S. S.

X-RAYS.

2603. Absorption and Scattering of X-Rays. D. Blockinzew and F. Halperin. *Phys. Zeits. d. Sowjetunion*, 7. 2. *pp*. 175–188, 1935. *In German*.—The photoelectric K-absorption coefficient in metals is calculated. The values of the absorption coefficient obtained from this calculation agree with those obtained by experiment. With the help of the formula given in the paper the value of the scattering coefficient for a metal can be estimated. J. T.

2604. Scattering of X-Rays by Polyatomic Liquids. *n*-Heptane. W. C. Pierce. *J. Chem. Phys*. 3. *pp*. 252–255, *May*, 1935.—A Fourier integral analysis of Katzoff's data for the X-ray scattering of *n*-heptane gives not only the arrangement of molecules in the liquid, but also the most probable distances within the single molecule. It is shown that the molecule consists of a zigzag carbon chain. Adjacent molecules are somewhat oriented and increase in temperature makes a more random condition. The Fourier integral theorem is shown to be valid even though the function for which it is used does not converge within the limits of the data. The distribution function is used to calculate the intensity, giving a fair agreement with the experimental values. AUTHOR.

2605. Intensity of the Radiation Scattered by Moving Electrons. E. C. G. Stueckelberg. *Helv. Phys. Acta*. 8. 2. *pp*. 197–204, 1935. *In German*.—In the determination of the Klein-Nishina formula for scattering of unpolarised light by moving electrons [see Abstract 1001 (1935)], a Lorentz transformation was applied after averaging with respect to the direction of polarisation had been carried out. The legitimacy of this procedure is here discussed. It is shown to be valid. W. S. S.

2606. Precision Measurement of $K\alpha_{1,2}$-Doublets of Light Elements. P. Haglund. *Zeits. f. Physik*, 94. 5–6. *pp*. 369–376, *April* 2, 1935.—The $K\alpha_{1,2}$-doublets of Al, Si and S are resolved and measured with the aid of a vacuum spectrometer. The dispersion curve of mica is discussed, also its use as a correction curve for anomalous dispersion. J. T.

2607. Fluorescent Yield, Intensity Ratios and Absorption in the L-Series of Heavy Elements. H. Küstner and E. Arends. *Ann. d. Physik*, 22. 5. *pp*. 443–472, *April*, 1935.—The fluorescent yields for the L-radiation of the elements Ta, W, Ir, Pt, Au, Pb, and Bi are determined by the method previously described by Arends [see Abstract 2159 (1935)]. For the L_I and L_{III} shells it is found that the fluorescent yields u_I and u_{III} increase with increasing atomic number, as in the K-series, whereas u_{II} diminishes. The energy ratios of the wave-lengths excited at the various levels are compared. It is found that E_{III}/E_{II} increases with increasing atomic number and that $(E_{II} + E_{III})/E_{I}$ decreases. The laws governing absorption in this region are also fully investigated. J. T.

2608. Intensity Ratios of Fluorescent X-Ray Emission Lines in the L-Region and their Dependency on the Voltage. H. Hirst and E. Alexander. *Phil. Mag.* 19. *pp.* 918–927, *May,* 1935.—The dependency on the tube-voltage of the intensity ratios of the L-emission lines of W, Tl and U when excited by X-rays has been investigated. It was found that the value of the ratios of lines originating from the same electron level are independent of the tube-voltage. The other intensity ratios depend critically on the voltage; they reach their maximum values at a voltage from three to four times the excitation voltage. The intensity ratios of the L-lines are the same, whether the lines are excited by kathode-rays or X-rays. AUTHORS.

2609. Effects of Chemical Combination on the L-Absorption Limits of Ta, W, Au and Pb. S. Kawata. *Phys. Math. Soc. Japan, Proc.* 17. *pp.* 89–99, *March,* 1935. *In English.*—Strange behaviour of calcium tungstate and gold chloride in the absorption of W and AuL_{β_5} lines reported in the previous research [see Abstract 1267 (1932)] is again observed for tungstic acid, and aurous and auric oxides. As the shifts of the L_{III} absorption limits by the chemical combination seemed very small for W and Au this effect is now carefully examined for Ta, W, Au and Pb absorption limits. The L_{III} shifts are, in volts, + 2·0 for tantalic acid, + 3·0 for tungstic acid, − 4·6 for aurous oxide, − 3·4 for auric oxide, + 3·4 for lead oxide and + 6·8 for lead peroxide. From these results the assumption of the selection rule in the appearance of the X-ray absorption limit is supported, and it is pointed out that in establishing the theory of the effect of combination on the X-ray absorption limit this point will have to be taken into account in the first place. In addition to the comparator measurements a microphotometric study is also made, by which means peculiar appearance of double edges is observed in the L_{II} absorption limit of Au in the case of auric oxide. AUTHOR.

2610. Absorption Spectra for Long-Wave X-Rays. V. H. Sanner. *Zeits. f. Physik,* 94. 7–8. *pp.* 523–530, *April* 8, 1935.—The L_{III}absorption edges for Al and Mg, and the M_V-absorption edge for Se are measured. Instead of continuous X-radiation, the short wave spark spectrum of Cu is employed. J. T.

2611. L-Spectrum of Mercury. Yvette Cauchois. *Comptes Rendus,* 200. *pp.* 1194–1196, *April* 1, *and pp.* 1314–1316, *April* 8, 1935.—The L-spectrum of mercury is studied by means of the focussing spectrograph and a modification of the technique previously described for gases [see Abstracts 5355 and 5356 (1933)]. The values obtained for the strong lines α_1, β_1, β_2, and γ_1 agree well with those of Friman, but in general there is not a good agreement with previous results. $L\alpha_1$ is found to be accompanied by two fine lines, α'_1 and α''_1, on the side of shorter wave-lengths. $L\alpha_0$ of Hg can be distinguished from the strong line $L\beta_3$ of W which appears on the spectrograms. The following values for the L-discontinuities are recorded: $L_I = 1092·40$, $L_{II} = 1046·44$, $L_{III} = 904·53$, and values for the M, N, and O levels are tabulated. The spectrum also contains weak dipole and quadrupole lines which are tabulated in the second paper. Good agreement between observed and calculated values is obtained. Some spark lines are also measured. C. B. A.

2612. Synthesis of X-ray Filtration Curves from Kramers' Emission Law. L. Silberstein. *Phil. Mag.* 19. *pp.* 1042–1054, *May,* 1935.—The empirical formula $I(x) = I(o)e^{-Ax-B\sqrt{x}}$, where $I(x) =$ total transmission of the filter at thickness x, and A and B are constants, which was used in a previous paper for determining the spectral composition of continuous X-radiation from its observed filtration or absorption [see Abstract 1928 (1933)], leads to values of the limit λ_0 of the X-ray emission which differ considerably from the quantum limit. It can be corrected to the modified form $I(x) = I(a)\ e^{-A(x-a)-B\sqrt{x-a}}$, when the radiation has been prefiltered through a thickness *a*. The absorption coefficient μ_m of the filter at the wave-length λ_m of maximum transmission can be evaluated from A, B, and *a*. Experiment shows that $\lambda_m/\lambda_0 = 3/2$. Such a result can be predicted on the basis of Kramers' theoretical emission law. It is then found that Kramers' law leads to a formula for the " filtration curve " of continuous X-radiation emitted at potential V, which is $I(x) = \left(e^{-\mu_0 x} - e^{-ax}\right) R(u)$, where $\mu_0 = \mu(\lambda_0) = \mu\ (12 \cdot 34/V)$, $a = \mu\ (\lambda = 0)$, μ being the absorption coefficient of the filter and x its thickness. R(u) is a " Röntgen " function which is tabulated. This formula gives very good agreement with experiment. C. B. A.

***2613. X-Ray Intensifying Screens. R. Berthold, N. Riehl and O. Vaupel.** *Zeits. f. Metallkunde,* 27. *pp.* 63–65, *March,* 1935.—A detailed investigation was made of the properties of a series of seven commercial intensifying screens suitable for metallurgical radiography. Three of the screens were of the zinc sulphide-cadmium sulphide type, three cadmium tungstate, and one zinc silicate. The influence of radiation intensity, grain size, thickness of active material, and colour of fluorescent light on the resolving power of the screens was examined. There is a considerable improvement in the resolving power of modern screens as compared with those of two or three years ago. It is shown that the chief factor affecting the resolving power of all screens is the intensity of the fluorescent light; curves show a very rapid increase in resolving power as the brightness of the screen image increases. The finer the grain of the fluorescent material the greater is the resolving power, but the latter is decreased by the use of thick layers of material. A further unfavourable effect may be produced by the scattering of the fluorescent light in the paste-board backing of the screen. Blue light screens seem to be slightly inferior to green or yellow-green, probably owing to the greater scattering of the shorter wave-lengths. J. E. R.

2614. Radiography of Fine Flaws in Metals. A. G. Warren. *Brit. J. of Radiology,* 8. *pp.* 235–247, *April,* 1935.—The most significant flaws which occur in metals are cracks. An examination is made of the conditions determining the visibility of cracks by a method involving the use of artificial cracks. Examples are given of typical cracks found in practice. In addition a method of radiography is outlined, which is applicable to cylindrical objects. J. T.

See also Abstracts 2508, 2759, 2760, 2762.

HEAT.

CALORIMETRY.

***2615. True Specific Heats of Metals and Alloys. K. Honda and M. Tokunaga.** *Tôhoku Univ., Sci. Reports,* 23. *pp.* 816–834, *March,* 1935. *In English. Report No.* 337 *of the Research Inst. for Iron, Steel and other Metals.*—Nernst-Lindemann's electrical method of determining the true specific heat has been improved. The present method has a number of advantages: The temperature-rise in specimens is reduced to a very small amount of one or two degrees, hence the exact value of true specific heat can be obtained: the temperature-rise is uniform throughout the specimen: the loss of heat by radiation and conduction can be accurately corrected. The true specific heats of some elements, Cu-Ni alloys, some light alloys, brass, and bronze have been determined at ordinary temperature. AUTHORS.

2616. Latent Heat of Fusion of Equilibrium Mixtures of Light and Heavy Water. L. Jacobs. *Faraday Soc., Trans.* 31. *pp.* 813–821, *May,* 1935.—The latent heats of fusion of 0, 29·67, 50·51, 76·36 and 97·70 per cent (molar percentage of D_2) heavy water have been measured using about ½ gram of the water in a Nernst calorimeter. The value of 1430 of the molar latent heat of fusion H_2O agrees well with the standard value 1435·5. If the difference is regarded as due to some inherent error in the present small calorimeter all the results given should be multiplied by 1·0033. The molar latent heats are given and shown as a curve and the molar heat of D_2O was obtained by extrapolation as 1525 ± 2 cal. A simple mixture theory gives the value of $L_3 - 8{\cdot}64\, t_3$ as 1494 where L_3 is the molar latent heat of HDO and t_3 is the melting-point of HDO. AUTHOR.

***2617. Electrical Differential Method for the Measurement of C_v of Gases. Part VI. Specific Heats of Argon and Air. M. Trautz and A. Reichle.** *Ann. d. Physik,* 22. 6. *pp.* 513–524, *April,* 1935.—Details of the apparatus employed in the electrical differential method for determining the specific heats of gases at constant volume (C_v) are given [see Abstract 1931 (1933)]. The following values are derived for the respective molecular heats at constant volume of argon and air at 16°C.: argon, 2·982 cal. per degree; air, 4·951 cal. per degree ± 2 parts per thousand. The theoretical value for argon is 2·979. J. S. G. T.

***2618. Leads and Formulæ in Electric Calorimeter Calibration. W. P. White.** *Rev. Sci. Instruments,* 6. *pp.* 142–143, *May,* 1935.—A brief discussion of the production of Joule heat in the leads, and of the effect of leads on the heat leak from the calorimeter. L. G. C.

See also Abstracts 2648, 2649.

CONDUCTION.

2619. Thermal Conduction in Electrostatic Fields. G. Groetzinger and R. Frey. *Phys. Zeits.* 36. *pp.* 292–298, *April* 15, 1935.—In this paper it is shown experimentally that the thermal conductivity of certain liquids is altered by an electrostatic field. With solids and gases free from a permanent electric moment, no such influence of an electrostatic field could be established. **H. Senftleben,** whose results are challenged by the authors, claims to be in agreement with those in the present paper, since the experimental arrangements were different, and these are now discussed. H. H. Ho.

2620. Theorems Relating to the Uniqueness of Solutions of the Heat Conduction Equation. A. Tichonov. *Comptes Rendus de l'Accad. des Sciences, U.S.S.R.* 1. *pp.* 294–300, *Feb.* 11, 1935. *In French.* —Solutions of the equation $\delta^2 u/\delta x^2 = \delta u/\delta t$, and conditions under which the solution reduces to Poisson's integral are discussed. J. S. G. T.

2621. Generalised Equation of Heat-Conduction. M. R. Siddiqi. *Indian. Journn. Phys.* 9. *pp.* 299–310, *March,* 1935.—Solution is sought of the non-linear equations of heat-conduction for non-homogeneous bodies, *i.e.*, of $\delta/\delta x\{p(x)\delta U/\delta x\} - \delta U/\delta t = U^2$, with boundary conditions $U(0, t) = U(\pi, t) = 0$ for all $t \geqslant 0$; $U(x, 0) = f(x)$ for all values of x between 0 and π. The solution $U(x, t)$ is determined in a series of Strum-Liouville characteristic functions $U(x, t) = \sum_{n=1} v_n(t)\phi_n(v)$. The problem of determining the coefficients $v_n(t)$ leads to an infinite system of non-linear integral equations which is solved by the method of successive approximations developed by the author. The uniqueness of the solution is proved. AUTHOR.

2622. Thermal Conductivity of Deuterium. A. B. van Cleave and O. Maass. *Canad. J. of Research,* 12. *pp.* 372–376, *March,* 1935.—The thermal conductivities of deuterium and some mixtures of deuterium and hydrogen have been measured by a relative " hot wire " method. The results are consistent with the authors' original conclusion that the deuterium molecule has the same molecular diameter as the hydrogen molecule. It follows also that the molecular heats of the hydrogen isotopes are the same. AUTHORS.

2623. Thermal Conductivity and Accommodation Coefficient of Carbon Dioxide. C. T. Archer. *Phil. Mag.* 19. *pp.* 901–918, *May,* 1935.—The thermal conductivity of CO_2 has been determined, using the hot-wire method, at different temperatures over a range of about 300° C., the values found varying from 0·0000347 at 0° C. to 0·0000894 cal. cm.$^{-1}$ sec.$^{-1}$ deg.$^{-1}$ at 318·8° C. A constant temperature oil-bath heated electrically was used, the temperatures being measured by means of platinum wire fixed on the glass walls of the tube system. The variation of the thermal conductivity of the gas with temperature has been found to obey a law of the type $K_T = C.T.^n$, in which $n = 1{\cdot}216$ for the range of temperature dealt with. The results do not indicate any change in accordance with the conclusions of Ibbs and Wakeman [see Abstract 2286 (1932)]. The accommodation coefficient of the gas in contact with a platinum surface at different temperatures over the same range of temperature has been obtained also from the observations, the values ranging from 0·51 at 24·2° C. to 0·28 at 331·8° C. AUTHOR.

2624. Heat Conductivity of Simple Cubical Crystals. M. Blackman. *Phil. Mag.* 19. *pp.* 989–998, *May,* 1935.—The theory of heat conductivity of crystals, due to Peierls [see Abstract 1912 (1930)] has been shown to account very simply for the remarkable regularity in the heat conductivity of the alkali halides discovered by Eucken and Kuhn. AUTHOR.

***2625. Apparatus for Measuring Thermal Conductivity of Metal Sheets. A. Eucken and H. Warrentrup.** *Zeits. f. techn. Physik*, 16. 4. *pp*. 99–105, 1935.—An apparatus is described for the determination of the thermal and electrical conductivity of metals in the form of thin discs. The principle of the method consists in supplying a measured quantity of heat to the centre of the disc and maintaining the circumference at a constant lower temperature. A radial flow of heat is thus produced and the thermal conductivity determined from observations of the temperatures of two concentric circles of the disc, a correction being applied to eliminate errors due to radiation and convection. The electrical conductivity can be measured in the same apparatus. Results are given for Al and Cu at a temperature of 0° C., the values obtained being in good agreement with existing data. R. W. P.

See also Abstract 2376.

CONVECTION.

2626. Heat Transfer by Convection. R. N. Asseykin. *Phys. Zeits. d. Sowjetunion*, 7. 1. *pp*. 115–119, 1935. *In German*.—As a result of a mathematical analysis of the process of heat transfer by convection, it is shown that if a, and a_2 are the respective heat transfer coefficients in the laminary boundary layer, and the adjoining layer, in which the transition from laminar to turbulent flow occurs, then $a_1/a_2 = k$ Pr where Pr is the Prandtl number, and k is a constant depending on the character of the fluid motion and the velocity in the plane of separation. R. W. P.

2627. Prandtl Equation for Heat Transfer. M. ten Bosch. *Zeits. f. techn. Physik*, 16. 4. *pp*. 105–107, 1935.—The physical basis on which the Prandtl equation is founded leads to a choice of two mean fluid temperatures, in the turbulent region and in the laminar film. By introducing an approximate expression for the loss of pressure due to non-isothermal flow all experimental results for water, air and oil can be brought into good agreement with the Prandtl equation. The present agreement is better than that given by the modification recently suggested by Kuprianoff [see Abstract 1188 (1935)]. R. W. P.

DILATATION.

2628. Thermal Expansion of Monocrystalline and Polycrystalline Antimony. P. Hidnert. *Bureau of Standards, J. of Research*, 14. *pp*. 523–544, *May*, 1935.—Measurements were made on the linear thermal expansion of 11 samples of single crystals of Sb and 3 samples of polycrystalline Sb at various temperatures between 20 and 560° C., and the data were correlated with the results obtained by previous investigators to 300° C. The linear expansion along the trigonal axis (0° orientation) of a single crystal is about twice as large as the expansion along a direction perpendicular to this axis (90° orientation). Equations were derived which show the relationships between the coefficients of expansion and the orientations of single crystals. The linear thermal-expansion curves of polycrystalline Sb show that there is no polymorphic transition between 20 and 560° C. The differences in the linear expansion of different samples of polycrystalline Sb are attributed to variations in the average orientation of the crystals. AUTHOR.

MELTING AND BOILING POINTS.

***2629. Melting Curves and Compressibilities of Nitrogen and Argon. P. W. Bridgman.** *Am. Acad., Proc.* 70. *pp.* 1–32, *March*, 1935.—Apparatus is described for the measurement of the temperature and pressure coordinates of the melting curves of the permanent gases. The pressure was applied by means of a leak-proof piston, the change of phase being indicated by discontinuity in the motion of the piston as a function of pressure. The cylinder in which the freezing occurred had to be maintained at a constant temperature at any desired point in the range 77° K. to 185° K., and a thermostat is described for this purpose. It consisted in maintaining a stirred bath of liquid propane at the desired temperature by the automatic and intermittent circulation of liquid air through copper coils immersed in the bath. Curves indicating the temperature at which melting occurs, and also the change in volume on melting are given for N_2 and A up to pressures of 5500 kg./cm.^{2}. Where comparison can be made the melting temperatures are somewhat higher than those obtained by Simon and a possible source of error in his method is suggested. Subsidiary determinations are made of the specific volumes of the gaseous phase. The latent heat of the transformation is calculated from Clapeyron's equation, and is found to have an almost constant value in the case of A, and to increase towards a constant value for N_2. In neither case do these results furnish any evidence for the existence of a critical point between the solid and amorphous phases. R. W. P.

2630. Solidification Diagrams for Alloys of Two Alkali Metals, K and Rb. E. Rinck. *Comptes Rendus*, 200. *pp.* 1205–1206, *April* 1, 1935.—The solidification diagram of K and Rb has been obtained. It indicates the two metals to be completely mixed in the solid state. The liquidus and solidus come very near together and have a flat minimum at 32·8° C corresponding to the composition K + 2 Rb. It was not possible to decide by means of the thermal analysis whether this minimum corresponded with an eutectic or a compound KRb_2, but subsidiary microscopic observations indicated that the two metals only form a series of mixed crystals. R. W. P.

2631. Supercooled Water Vapour. M. Jakob. *Zeits. f. techn. Physik*, 16. 3. *pp.* 83–86, 1935.—The paper deals with the supercooling of water vapour by expansion and refers to the work of J. I. Yellott (*Combustion*, 5. *p.* 22, 1933), who has suggested a slightly modified definition for the Wilson line—the lower limit at which condensation occurs. The formation of drops has been observed by an optical method, and it is concluded that the nuclei on which they form have a radius of $0 \cdot 62 \times 10^{-6}$mm. and probably consists of multiple molecules. A Mollier diagram showing the Wilson line is given in the present paper in which values obtained by Yellott are seen to be in agreement with those of Martin and Stodola. R. W. P.

2632. Correlation of Distillation Range with the Viscosity of Creosote. C. J. Frosch. *Physics*, 6. *pp.* 165–170, *May*, 1935.—The results of viscosity measurements of a series of creosotes distilled from a single tar are given. It was found that these creosotes are truly viscous solutions which permits the designation of the data as absolute viscosity. The viscosity-temperature data conform to two equations, one an empirical relationship previously found in an analogous series of crude oils, the other developed from theoretical considerations. It is remarkable that in spite of the complex nature of creosote, the viscosity data permit the material boiling below 355° C. to be regarded as solvent and the residue above that temperature as solute. This is not true for any other temperature limit customarily used in creosote analysis. [See following Abstract.] AUTHOR.

2633. Correlation of the Distillation Range with the Surface Tension of Creosote. C. J. Frosch. *Physics*, 6. *pp.* 171–173, *May*, 1935.—The surface tension of each of a series of creosotes distilled from a common tar has been determined at various temperatures. The surface tensions of the several creosotes do not differ substantially at any given temperature. Differences in the rates of penetration of such creosotes into capillary materials are regarded as due to differences in the viscosities or the solid-liquid contact angles. The Langmuir theory of surface phenomena has been applied to explain the similarity of the surface tension values. [See preceding Abstract and following Abstract.] AUTHOR.

2634. Correlation of Distillation Range with the Interfacial Tension of Creosote Against Water. C. J. Frosch. *Physics*, 6. *pp.* 174–177, *May*, 1935.—Measurements of interfacial tension against water of each of a series of creosotes distilled from a single tar are reported. It is found that the interfacial tension values of these creosotes varied as much as 30 % although no definite trend was present which could be related to other physical properties. Two possible theories to explain the differences in the interfacial tensions are discussed. [See preceding Abstract.] AUTHOR.

See also Abstracts 2419, 2638, 2703.

TEMPERATURE, MEASUREMENT OF.

***2635. Torsion Step-Spring Thermometer. W. Grundmann.** *Zeits. f. Instrumentenk.* 55. *pp.* 173–174, *April*, 1935.—Criticisms are made regarding the action and accuracy of this thermometer described by Karsten [see Abstract 4241 (1934)]. It is stated that it is not so accurate as a mercury thermometer. The assumption of no change in its action depends upon the removal of all elastic after-effects due to temporary or molecular changes which occur with all bimetallic elements. Also at 50° C. all such elements show a sudden change in the sense of rising temperature due to molecular changes. It is stated that this principle has already been used for a maximum and minimum thermometer. [See following Abstract.] R. S. R.

***2636. Torsion Step-Spring Thermometer. A. Karsten.** *Zeits. f. Instrumentenk.* 35. *pp.* 218–219, *May*, 1935.—The paper forms a reply to the remarks of W. Grundmann [see preceding Abstract]. Fatigue of the bimetallic strip occurs if the elastic coefficient alters either due to changes in the metal itself or in course of manufacture. In the first case the phenomenon is unavoidable if the bimetallic components both have high elastic coefficients, but such components are not usually suitable. Bimetallic strips with high elastic coefficients can decrease in elastic coefficient if fibres in the material are super-elastic, an effect shown by heat-treatment. These errors may arise from unsuitable choice of the geometrical form and this may also cause changes in the zero. Suitable choice of material, efficient preliminary treatment and choice of suitable geometrical form reduces these errors. R. S. R.

***2637. Photoelectric Thermoregulator. W. L. Walsh and N. A. Milas.** *Indust. and Engin. Chem.* (*Analytical Edition*), 7. *pp.* 122–123, *March*, 1935.—For controlling the temperature of a furnace a thermocouple was connected to a Leeds and Northrup potentiometer indicator; a strip of paper was pasted over the galvanometer needle and it was arranged that when the needle moved away from the zero position (at which the thermoelectric e.m.f. balanced the potentiometer e.m.f.) the illumination of a photocell was altered. According to the direction in which the needle moves, the heating current is reduced or increased to restore the balance. The accuracy of the control is given as 0·25° C. D. H. F.

2638. Adiabatic Demagnetisation of Paramagnetic Salts. W. J. de Haas and E. C. Wiersma. *K. Onnes Lab. Leiden, Comm.* 236*b*. *Physica,* 2. *pp.* 335–340, *April,* 1935. *In English.*—The influence of different field strengths has been studied for three salts, viz., ferric ammonium alum, cerium ethylsulphate and a diluted chromic alum. The influence is small for the ferric alum, zero for the cerium salt and rather large for the diluted chromic alum. With this salt a temperature of 0·0044° K. was reached. [See Abstract 1718 (1935).] AUTHORS.

See also Abstracts 2519, 2629.

THERMOCHEMISTRY.

2639. Highly Rarefied Flames of Potassium and Iodine Vapour. E. Roth and G. Schay. *Zeits. f. phys. Chem.* 28. *Abt.B.* 5. *pp.* 323–331, 1935.—The reaction $K + I_2$ is investigated by the method of highly rarefied flames. The $K + I_2$ flames behave very similarly to those of $K + Cl_2$ and $K + Br_2$ [see Abstract 1163 (1933)]. One of the most important differences is that in this case the secondary gas reaction does not supply the energy necessary for excitation of the violet K doublet so that both the first and the second stages of the reaction only excite the red doublet. By means of an exact analysis of the decrease of light intensity on overheating the reaction zone it is possible to calculate the heat of dissociation of the K_2-molecule by a method similar to that previously applied to Na flames. A value of 18·7 k.cal is found, this being in good agreement with recent spectroscopic data. From the distribution curve and the dependence of the light emission on pressure and temperature the constants of the elementary processes which contribute to the reaction are calculated. [See following Abstract.] J. E. K.

2640. Highly Rarefied Flames of Potassium and $HgCl_2$ Vapour. I. Berger and G. Schay. *Zeits. f. phys. Chem.* 28. *Abt.B.* 5. *pp.* 332–339, 1935.—The reaction $K + HgCl_2$ is investigated by the method of highly rarefied flames [see preceding Abstract]. The chemical mechanism is similar in all respects to that of the corresponding Na flames. The second stage of the reaction, $K + HgCl = KCl + Hg$, leads to the emission of the red and violet K doublets. The red doublet is not excited directly but by primary excitation of the 3^2D level. The amount of emission of both kinds of light shows all the features of Polanyi and Schay's type II emission characteristic of $HgCl_2$ flames. The $HgCl_2$ molecules also react on the walls with K molecules, this reaction providing an intense blue-violet wall light. The HgCl radicals also enter into a wall reaction as a result of which occurs the electric conductivity and continuous emission previously found in all other K flames. J. E. K.

2641. Lower Limit of Ignition of Hydrogen-Oxygen Mixtures. W. E. Garner and H. J. Willavoys. *Faraday Soc., Trans.* 31. *pp.* 805–811, *May,* 1935.—The lower limits for the ignition of hydrogen-oxygen mixtures in the molar ratios 3 : 1, 2 : 1, 1 : 1, and 1 : 2 have been determined in silica vessels for the temperatures 350–600° C. In a few cases, the upper limits have also been measured. The values for the lower limits are much lower than those obtained by previous workers and the equation $\log p_1 = ke^{E/RT}$, is found not to be in agreement with the results obtained. The activation energy varies from 7000 at the high temperatures to approximately 15,000 cal. at the low temperatures. The values of the limits near the critical ignition pressure are very much affected by the state of the silica surface. In agreement with Frost and Alyea it has been found that the lower limit is more dependent on the oxygen pressure than on any other single factor. AUTHORS.

2642. Ignition of Gaseous Mixtures by the Corona Discharge. R. W. Sloane. *Phil. Mag.* 19. *pp.* 998–1011, *May,* 1935.—It was not found possible to ignite any coal-gas-air mixtures by discharge between the surfaces of good insulators such as paraffin wax, ebonite, or cold glass. It is possible to ignite inflammable coal-gas-air mixtures by discharge between the surfaces of less good insulators such as white fibre, glass at 100° C., or slate. Mixtures of 12 to 20 % coal-gas in air may be ignited by the induction-coil discharge between glass electrodes at about 100° C. 5 mm. apart when the total energy of the discharge is about 0·003 joule. A steady corna discharge between slate electrodes 3 or 4 mm. apart carrying a current of about 300 μA will ignite the most easily ignited coal-gas-air mixture. The steady corona discharge between metal points 3 to 6 mm. apart will ignite the most easily ignited coal-gas-air mixture when the current is greater than 300 μA. AUTHOR.

See also Abstracts 2322, 2336, 2651.

THERMODYNAMICS.

2643. Basis of Thermodynamics. F. v. Krbek. *Zeits. f. Physik,* 94. 3–4. *pp.* 204–210, *March* 19, 1935.—The author discusses first how temperature may be considered as a function of space and time, this involving a 4-dimensional system with time as the fourth parameter. With the help of certain axioms he derives the Carnot process while if small volume elements are considered for a reversible process $\int dv \int \frac{dQ}{T} = 0$, but if the temperature varies from point to point this double integral is negative. He leads on from this to the 2nd law of thermodynamics and with its help derives the equation for a perfect gas in the form $pv = n$ RT where n is the number of molecules. R. S. R.

2644. Critical Temperature of Heavy Water. E. H. Riesenfeld and T. L. Chang. *Zeits. f. phys. Chem.* 28. *Abt. B.* 5. *pp.* 408–409, 1935.—For D_2O, by comparison with H_2O, the value found is 371·5°. F. I. G. R.

2645. Critical State and Continuity Theory. I. Traube. *Kolloid Zeits.* 70. *pp.* 302–305, *March,* 1935.—The author concludes a brief critical review of work challenging Andrews' assumption, that at the critical point the densities of a liquid and its vapour coincide, by re-affirming a postulate first advanced in 1902 that in the neighbourhood of this point there exist " gasone " and " fluidone " phases differing in co-volume from the gaseous and liquid phases. Such special phases may arise from variations in the loose combination of molecules under van der Waals forces. L. V. C.

2646. Theory of the Perfect Gas. W. Glaser. *Zeits. f. Physik,* 94. 5–6. *pp.* 317–328, *April* 2, 1935.—By application of the Wien displacement law of light to material waves, the general form of the energy distribution function has been determined for a relativity corpuscular gas, which must be necessarily fulfilled when the validity of the two chief laws of thermodynamics and the law of the conservation of energy and momentum are assumed. The Wien law is contained therein as a special case. The various changes are worked out for the case where the light quantum (in the de Broglie sense) is regarded as a finite static mass. The paper is entirely mathematical. H. H. Ho.

2647. Equation of State of Real Gases. W. Fritz. *Phys. Zeits.* 36. *pp.* 217–220, *April*, 1935.—It is shown that the equation of state proposed by Honigmann [see Abstract 1324 (1931)], viz., $d(pv) = (n - 1)/n \times di = (n - 1)\, du$, where n is a constant, i is the enthalpy, u is the internal energy and p and v have their usual meanings, often agrees with the experimental results obtained with real gases and vapours. This is also true for the adiabatic equations $pv^n =$ constant, and $\mathrm{T}p^{(1-n)/n} =$ constant. Data are tabulated comparing the results obtained when the principal steam tables are used in connection with the Joule-Thomson process. R. W. P.

2648. Heat Capacities and Dissociation Equilibria of Gases. B. Lewis and G. v. Elbe. *Am. Chem. Soc. J.* 57. *pp.* 612–614, *April*, 1935.—Accurate data of heat capacities and dissociation equilibria derived from band spectroscopic data of gases have been gathered and arranged in two tables. One contains the energy content of H_2, O_2, N_2, CO, NO, OH, CO_2, H_2O, O_3, Br_2 and HBr from 200 to 3500° K.; the other contains equilibrium constants of numerous equilibria involving these gases and also Cl_2 and HCl from 300 to 5000° K. Complete references to sources of data are given. AUTHORS.

2649. High Temperature Heat Capacities of Oxygen. H. L. Johnston and Margery K. Walker. *Am. Chem. Soc., J.* 57. *pp.* 682–684, *April*, 1935.—Tables of the heat capacity, entropy, free energy and dissociation of O_2, based on spectroscopic data, have been revised to take account of the existence of the $^1\Delta$ electronic state, previously expected. The calculations are based on Herzberg's measurement of 7882 cm.$^{-1}$ (equivalent to 0·97 V) for the separation of the zero vibrational levels of the ground $^3\Sigma$ and metastable $^1\Delta$ states of the molecule, which confirms Ellis' and Kneser's measurements at lower dispersion. Certain reasonable assumptions, which do not appreciably influence the final calculated values, are made for the anharmonic constant in the vibrational energy formula of the $^1\Delta$ state. Influence of the $^1\Delta$ term is insignificant below 3000° K., for the dissociation, and contributes less than 0·002 cal. to the molal free energy function below 1750°; to the molal entropy below 1250°; and to the molal heat capacity below 1000°. A table of molal energies for the temperature interval 90 to 5000° K. is included. The $^1\Delta$ contribution to the heat capacity attains a maximum, which amounts to nearly 0·6 cal., in the neighbourhood of 4500° K., in agreement with the general behaviour of electronic heat capacity contributions. Comparison with the explosion data of Wohl and Magat and of Lewis and v. Elbe indicates that the method of the former gives values which are too low and that of the latter, results which are somewhat too high. H. H. Ho.

2650. Free Energy of Polyatomic Molecules from Spectroscopic Data. Part II. A. R. Gordon. *J. Chem. Phys.* 3. *pp.* 259–265, *May*, 1935.—The methods already developed [see Abstract 1237 (1934)] for computing the free energy from spectroscopic data for diatomic molecules and for triatomic unsymmetrical rotators are extended to handle the case where one or more of the fundamental frequencies is degenerate. New tables, necessary for such calculations, have been computed, and the procedure is illustrated by sample calculations for nitrous oxide, hydrogen cyanide and acetylene. AUTHOR.

2651. Specific Heats of a Liquid and its Vapour and Heats of Reaction in Liquid Mixtures. D. B. Macleod. *Faraday Soc., Trans.* 31. *pp.* 746–748, *May,* 1935.—The author finds, from a study of available data, that there is an almost constant difference of about 9 cal. between the gram-molecular heats of liquids at ordinary temperatures and their vapours at the same temperature. The above difference is much greater than the work done to expand the liquid against the internal forces, and must be largely due to the greater number of degrees of freedom in the liquid condition. After discussion, the author concludes that apart from the energy of vibration of the atoms within the molecule, which a liquid at any given temperature might be expected to share in common with its vapour at the same temperature, a liquid molecule might be expected to have 15 degrees of freedom made up as follows: 6 of kinetic and potential energy due to translation, 3 of rotation, and 6 degrees of distortional. Application of the above ideas is made to the heat evolved on admixture of pairs of liquids since this is of the order of 5000–6000 cal./cm. molecule, and an explanation given of the approximate constancy of this amount for different pairs of liquids. H. H. Ho.

2652. Supposed Inadequacies of the Nernst Heat Theorem. V. Njegovan. *Zeits. f. Physik,* 94. 5–6. *pp.* 377–385, *April* 2, 1935.—By application of internal thermodynamics [see Abstract 1735 (1935)] the apparent deviations from the Nernst heat theorem are explained.

R. W. P.

2653. Statistical Mechanics of Fluid Mixtures. J. G. Kirkwood. *J. Chem. Phys.* 3. *pp.* 300–312, *May,* 1935.—Expressions for the chemical potentials of the components of gas mixtures and liquid solutions are obtained in terms of relatively simple integrals in the configuration spaces of molecular pairs. The molecular pair distribution functions appearing in these integrals are investigated in some detail, in their dependence upon the composition and density of the fluid. The equation of state of a real gas mixture is discussed, and an approximate molecular pair distribution function, typical of dense fluids, is calculated. Applications of the method to the theory of solutions will be the subject of a later article. AUTHOR.

2654. Derivation of Thermodynamical Relations for a Simple System. A. N. Shaw. *Roy. Soc., Phil. Trans.* 234*A*. *pp.* 299–328, *May* 31, 1935.—Employing a simple Jacobian notation, a systematic direct procedure of effecting any desired transformation of partial derivatives and yielding many millions of relationships between such derivatives with a minimum of analysis is outlined. Compact tables facilitating the transformations are derived and the methods are applied to special cases, *e.g.*, a given equation of state, perfect gases, vapours kept saturated, radiation, etc. The underlying theory is based on the equations $(dx/dy)_z = \mathrm{J}(x, z)/\mathrm{J}(y, z)$; $\mathrm{J}(\mathrm{T}, \mathrm{S}) - \mathrm{J}(p, v) = 0$; $\mathrm{J}(x, y)\cdot\mathrm{J}(z, w) + \mathrm{J}(y, z)\cdot\mathrm{J}(w, x) + \mathrm{J}(z, x)\cdot\mathrm{J}(y, w) = 0$; $\mathrm{J}[\mathrm{J}(x, y), z] + \mathrm{J}[\mathrm{J}(y, z)x] + \mathrm{J}[\mathrm{J}(z, x), y] = 0$, when x, y, z and w are functions of α and β, *e.g.*, p and T. The time-saving characteristics of the procedure are illustrated.

J. S. G. T.

2655. Thermodynamics of Chemical Gas Equilibria. A. J. Rutgers. *Zeits. f. phys. Chem.* 173. *Abt. A.* 2. *pp.* 73–88, 1935.—The usual thermodynamic derivation of the law of mass action rests on the assumption that the pure reactants can be withdrawn from the reaction mixture. This is not the case with dissociation processes. For a process of the type $2\,HCl \rightleftarrows H_2 + Cl_2$, it is necessary to consider, not the undissociated 2 HCl, but the mixture of $2(1 - x)$ HCl, xH_2 and xCl_2. When this is done, the same expression as formerly is obtained for the maximum work, but this relates to the process by which $1H_2$ and $1Cl_2$ are transported, not into 2 mols. of undissociated HCl of pressure p_{HCl}, but into 2 mols. of equilibrium mixture in which HCl has the partial pressure p_{HCl}. The old expression for the maximum work of the reaction $A + B \rightarrow C + D$ may be similarly interpreted. Two new derivations are given for the reaction isochore, use being made of (1) the reduced heat quantities, and (2) the maximum work and its known dependence on the temperature. The law of mass action, and the equation for the reaction isochore for dissociations which proceed with change in the number of molecules are derived from similar considerations. T. H. P.

2656. Elementary Deduction of the Fundamental Statistical Formulæ of Chemical Thermodynamics. G. Šubin. *Comptes Rendus de l'Acad. des Sciences, U.S.S.R.* 1. *pp.* 301–307, *Feb.* 11, 1935. *In German.*—Formulæ for the generalised canonical distribution within the phases of a system of many degrees of freedom are derived both for the classical and quantum theories. J. S. G. T.

See also Abstracts 2422, 2711, 2722, 2723, 2724, 2730.

VAPOUR PRESSURE.

2657. Calculation of Vapour Pressures of Aqueous Solutions. L. Frank. *Zeits. f. Physik,* 94. 5–6. *pp.* 408–410, *April* 2, 1935.—A method of calculating the vapour pressures of concentrated aqueous solutions by means of Dühring's rule and data relating to the freezing and boiling points of the solutions is explained and illustrated by satisfactory calculated results relating to solutions of the alkali and other metals. J. S. G. T.

2658. Vapour-Pressure Curves of Thallium at Very Small Vapour Densities. F. Müller. *Helv. Phys. Acta,* 8. 2. *pp.* 152–164, 1935. *In German.*—By means of the method of line absorption a relative determination of the vapour pressure of Tl in the range of pressure from $1{\cdot}2 \times 10^{-6}$ to $7{\cdot}4 \times 10^{-4}$ mm. Hg was carried out. The following formula for the vapour pressure was found suitable in the region from 350° C. to 1200° C.: $\log_{10} p = - 52{\cdot}23\,A/T + B$, where A and B are constants depending on the temperature. J. J. S.

2659. Vapour-Pressure Measurements on "Apiezon" High-Vacuum Grease. G. Seydel. *Zeits. f. techn. Physik,* 16. 4. *pp.* 107–109, 1935.—The vapour pressure of Apiezon high-vacuum grease has been measured using a method described by Volmer. When first taken from the packing it has an apparent vapour pressure of some 10^{-5}mm. Hg. After a few hours in high vacuum at room-temperature it falls to about 5×10^{-7}mm. Hg. On warming, the more volatile constituents are quickly removed, after which the vapour pressure is less than 10^{-7}mm. Hg. Extrapolation of a vapour pressure curve obtained over the temperature range 170° C. to 130° C. indicates a room-temperature value of the order of 10^{-10} to 10^{-11}mm. Hg. for the " de-gassed " grease. R. W. P.

See also Abstracts 2483, 2484.

ACOUSTICS.

***2660. Projection of Harmonic Curves in Space. W. C. Dod.** *Acoustical Soc. of America, J.* 6. *pp.* 279–281, *April,* 1935.—A mechanical device is described by means of which three simple harmonic motions at right angles are compounded. In one case two of these have the same frequency and amplitude and differ 90° in phase (*i.e.*, the motion is circular) whilst the third may have any amplitude frequency and phase. The essentials in this simple case consist of a white enamelled pencil mounted on the flat end of a motor pulley so as to sweep out a cylinder as the motor runs, and a paper card having a single slit at the centre which is driven to and fro by any vibrating mechanism. The vibrating card causes a lantern to project a sheet of light which flickers one way and another with S.H.M. When the cylinder generated by the revolving pencil intersects the sheet of light, luminous curves are seen—representing sine curves wrapped on a cylinder. A description is also given of a more complicated apparatus which produces 3-dimensional curves of 'extreme complexity and beauty.' A. B. W.

2661. Sound and Vibration of the Drum. J. Obata and T. Tesima. *Acoustical Soc. of America, J.* 6. *pp.* 267–274, *April,* 1935.—Four kinds of drum used in religious functions, music and so forth in Japan are mentioned and the O-daiko, a large cylindrical drum, is investigated to find the relation between the sound and the vibration. The sound is picked up by a microphone placed about 150cm. from the centre of the drum and the vibration by a parallel plate condenser formed between a micrometer head and strips of tin foil pasted on the surface of the drum. Records of each of these, after valve amplification are shown on an oscillograph. The vibrations consist (*a*) of coupled vibrations of the two membranes, the coupling being mainly by the air column but also, and especially in the shallow drum, by the wooden body, and (*b*) of the normal modes, fundamental and harmonics of the vibration of the struck membranes. The pitch of the fundamental tone is lowered by increasing the length of the body, but the higher partials are unchanged. H. M. B.

2662. Damping of Large Amplitude Sound Waves. K. O. Lehmann. *Ann. d. Physik.* 20. 5. *pp.* 533–552, *Dec.,* 1934.—Stationary waves of large amplitude are excited in air of normal density in a tube of 6·7cm. dia., pressures of 75000 bars being obtained at the pressure antinodes. The damping of the vibrations is investigated. The damping constant shows scarcely any change up to pressure amplitudes of 30,000 bars, but increases at greater amplitudes owing to the onset of turbulence. Measurements carried out at pressures up to 2 atmospheres show that the damping varies inversely as the square root of the gas pressure for small amplitudes, in agreement with the theory of Helmholtz and Kirchhoff, although the absolute magnitude of the damping constant differs considerably from the theoretical value. J. E. R. C.

2663. Organ Pipes and Vowel Quality. A. T. Jones. *Acoustical Soc. of America, J.* 6. *pp.* 282–283, *April,* 1935.—The vowel sounds *ah—oo* are produced by an open organ pipe which is blown steadily while the hand alternately leaves the mouth free and then shades it. The effect is good with a pipe having a frequency round about 600, but change of frequency modifies the vowel sounds produced. The explanation appears to lie in the weakening which the shading causes in the higher components of the pipe. G. E. A.

2664. Propagation of Sound in the Atmosphere. T. Sakai and S. Syôno. *Geophys. Mag., Tokyo,* 8. *pp.* 205–218, *March,* 1935. *In English.*—The anomalous propagation of sound over short distances cannot be explained by calculations based on geometric reflection and refraction. Accordingly the authors have abandoned the conception of sound rays and have used the wave equations. The problem is simplified by considering the atmosphere to consist of only two homogeneous layers, the upper layer extending to infinity. The effect of the wind is included as a correction to the main calculation and is, it is stated, not strictly allowed for. Despite these simplifications, however, the authors claim to have achieved some success in explaining several hitherto unexplained phenomena in the propagation of sound over short distances. J. E. R. C.

2665. Supersonic Velocity in Dry and Humid Air. C. Ishii. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 560. *pp.* 201–208, *March,* 1935. *In English.*—The theoretical and experimental formulæ for the supersonic velocity in humid air, as found previously [see Abstract 313 (1933)], were further tested by measurements of nodal strata formed by stationary waves in dry air and in air with definite humidity. Known values of humidity were obtained by using saturated aqueous solutions of Na and K salts. For frequencies from 288 kc to 2892 kc the wave-length increases with the vapour pressure, e. The velocity V_h in humid air is, in terms of the velocity V_1 in dry air, $V_h = V_1(1 + Ae)$. The coefficient A decreases as the frequency increases, and since the velocity in dry air increases with the frequency, it is concluded that the effect of humidity diminishes with increase of frequency. It is thought that dispersion of velocity occurs with frequencies below 1000 kc. G. E. A.

2666. Diffraction of Light by Supersonic Waves. M. Sansoni. *N. Cimento,* 12. *pp.* 35–48, *Jan.,* 1935.—Gives a sketch of Brillouin's theory of the effect and a brief description of the experiments of Lucas and Biquard. [See Abstract 401 (1935.] W. S. S.

***2667. Triple-Quartz-Plate Supersonic Generating and Receiving System. H. L. Yeagley.** *Rev. Sci. Instruments,* 6. *pp.* 148–153, *May,* 1935.—This treatise is an exposition of the measurement of h.f. sound by means of an originally designed and constructed apparatus, together with results obtained and the interpretation thereof. The apparatus consists of a high precision, supersonic, sending and receiving system of a triple-quartz-plate type. Two of the piezo-quartz plates used act as supersonic transducers to transform electromagnetic energy into gas pressure waves and to retransform them. The third plate, of the same frequency, controls the oscillations of an external valve circuit, the output of which drives and controls the frequency of the first transducer plate in the gas chamber, within extremely narrow limits. An original interference method is used to eliminate troublesome standing waves along the supersonic path. The signal, amplified for observation, is the vector sum of the electromagnetic wave impressed on the receiver by the retransformed energy and a controlled direct pick-up through the capacity coupling of the high voltage leads to the gas chamber. The amplifier consists of two stages of radio-frequency amplification and a peak tube voltmeter. By this means absorption constant values are obtained to three significant figures. Velocity measurements may be made to include four significant figures. AUTHOR.

2668. Transmission of Sound by a Series of Equidistant Partitions. D. G. Hurst. *Canad. J. of Research,* 12. *pp.* 398–407, *March,* 1935.—The transmission of normally incident sound waves through a series of similar, equally spaced partitions has been calculated for the cases of infinite partitions and of circular partitions. The transmission characteristics depend on the solution of simultaneous linear difference equations for the velocity potentials. The array of partitions possesses interesting properties as a filter, and to illustrate these the change in intensity levels due to glass partitions is calculated numerically for 1, 2, 5, and 10 partitions. [See Abstract 3834 (1934).] AUTHOR.

2669. Sound Radiation from a Piston Diaphragm. H. Stenzel. *E.N.T.* 12. *pp.* 16–30, *Jan.,* 1935.—After reviewing earlier attempts at calculating the sound radiated from a diaphragm the author deduces a general formula which gives the sound pressure at any distance from its centre. Several new functions the properties of which are investigated appear in the formula and tables of numerical values are given. The sound pressure at a point is shown to be a function of $k\rho$ and kr, ($k = 2\pi/\lambda$, ρ = radius of diaphragm and r = distance of point from its centre). The sound pressure is calculated for $k\rho = 1$, 6 and 10 and for $kr = 1$, 2, 3, 4, 6, 8 and 10, the results being exhibited as polar curves. J. E. R. C.

2670. Physical Problems of the Physiology of Hearing. G. v. Békésy. *E.N.T.* 12. *pp.* 71–83, *March,* 1935.—The paper gives an account of the directions of present-day aural research. It opens with a full, illustrated description of the structure of the ear. The tympanum is conical and is provided with a muscle for tightening it; some persons can use this muscle at will. The chain of ossicles enables vibrations to reach the oval window before they arrive at the round window, and hence to set up a pressure difference and a fluid motion between the two windows. The Reissner, tectorial and basilar membranes all vibrate in the same phase, so that physically they can be represented by one mechanism. The resonance theory of hearing is favoured by physicists, but certain facts relating to the cochlear structure and to nerve currents support the telephone theory. The experiments of Wever and Bray and others on electrical currents in the auditory nerves are described [see Abstract 3859 (1930)]. The hypothesis that the cochlea is the seat of the mechanical analysis of frequency is supported by several facts. The question of the identity of reception of air-borne sounds and sounds conducted through bone is dealt with. By supplying sounds of the same amplitude but of opposite phase by air and by bone respectively, the resultant effect is no sound. Other points discussed are: the investigation of vibrations in the ear-fluids by means of models: the damping of vibrations in ear structures and the non-linear character of the overtones associated with the ear. By applying a pressure to one side of the tympanum the stirrup bone is slightly displaced with the effect that two tones of frequency, 2000 and 2260, are less easily heard, whilst their difference tone 260 increases greatly in loudness. G. E. A.

2671. Electrical Phenomena of Cochlea and Auditory Nerve. H. Davis. *Acoustical Soc. of America, J.* 6. *pp.* 205–215, *April,* 1935.—When electrical contact is made with the auditory nerve of a decerebrate cat, and the potentials developed in it are amplified and delivered to a telephone receiver, sounds and words delivered to the animal's ear can be heard and recognised. The paper contains the summarised results of a large number of researches which have followed this discovery, and particularly those which serve to illuminate the mechanism of sound reception in the ear. Mechanical movement is transmitted from the tympanum to the basilar membrane, the part affected by low tones being a considerable zone toward the apical end of the membrane, while a high tone affects a smaller zone near the round window, and the resonance of the membrane is that peculiar to a continuous structure. The vibrating mechanisms are almost, but not quite, critically damped. The sound waves supply energy which develops a p.d. between the upper and lower ends of the sensory cells of the organ of Corti, and nervous impulses are set up only during the outward movement of the tympanum. Differentiation of pitch depends on the activity of one or another zone of the basilar membrane and on consequent differences in the distribution of activity among the fibres of the auditory nerve. Loudness depends on the number of active fibres irrespective of the frequency of the impulses in those fibres. G. E. A.

2672. Acoustical Functions of the Larynx. E. G. Richardson. *Univ. Durham Phil. Soc., Proc.* 9. *pp.* 146–152, *Dec.*, 1934.—The function of the false vocal cords is discussed. It is suggested that the tone produced by the true vocal cords is modified by the false vocal cords, the fundamental being enhanced and the sound purified. The further modifications imposed on this tone by the resonant cavities of the throat, nose and mouth are discussed. These resonances are considered to be so broad on account of the flexible nature of the walls that, within limits, the wave form of a vowel is preserved as the cord note is changed. The wave forms obtained by Curry [see following Abstract] indicate that the air vibrations excited by the vocal cords are of the nature of relaxation oscillations, the forced vibrations of the air columns dying down after each of the periodic impulses of the cord fundamental. J. E. R. C.

2673. Speech Analysis by Kathode-Ray Oscillograph. R. Curry. *Univ. Durham Phil. Soc., Proc.* 9. *pp.* 153–163, *Dec.*, 1934.—Oscillograms of Northern and standard English speech sounds are obtained, several being reproduced. The same speech sound produced by different speakers is shown to give rise to an oscillogram of the same general pattern. The oscillograms are analysed and the results correlated with physiological evidence to deduce the functions of the larynx, mouth and throat in the production of speech sounds. [See preceding Abstract.] J. E. R. C.

2674. Quantitative Studies on the Human Voice. S. K. Wolf, D. Stanley and W. J. Sette. *Acoustical Soc. of America, J.* 6. *pp.* 255–266, *April*, 1935.—Recently developed acoustical devices have made possible the inauguration of a series of physical tests on the singing voice, and intensity as a function of time and pitch, vibrato and quality were studied by means of an automatic level recorder, a crystal analyser and an acoustic spectrometer. Pitch-intensity measurements were made for more than fifty voices, beginners and professionals, soprano, alto, tenor and baritone, who sang the note " ah," etc., at full intensity over their whole range, at whole tone intervals, each note for five seconds. There is, in general, a relatively smooth rise of intensity with pitch for the composite curves derived, for the notes, ah, ay and oo, from baritones. For the vowel ee there is a sudden drop in intensity at A below C 261·6. This effect is accompanied by a change in quality, but is not always present, even in the same voice. It was also noticed in a good contralto. Two reference curves were made, one for male voices and the other for female, by means of which individual voices could be tested, *e.g.*, beginners to note progress in development of the voice. In the reference curves there is a uniform rise in intensity with pitch, except at the upper end. Hypotheses to explain the increase are stated. The maximum power values for men and women were both of the order of 1 watt. Vibrato records are shown, discussed and classified, also analyses of the partials in different voices as recorded by the acoustic spectrometer. G. E. A.

2675. Absorption of Sound in Gases. V. O. Knudsen. *Acoustical Soc. of America, J.* 6. *pp.* 199–204, *April,* 1935.—The authors' experiments upon the absorption of sound in O_2 and air are discussed in relation to Kneser's theoretical work [see Abstract 5391 (1933)] on this subject. Kneser's prediction that the sound absorption in a gas at a given frequency should pass through a maximum as the concentration of a given impurity is varied is confirmed. It also appears that the value of the maximum absorption is proportional to the frequency: this is also predicted by Kneser's equations. A result, which does not appear to have any rigorous theoretical explanation is also obtained, viz., that the concentration at which maximum absorption occurs is proportional to the frequency for all impurities except H_2O. By using this result it is possible to deduce absorption coefficients which fit the observed values very well. Kneser's calculations indicate that the number of transitions between the excited and unexcited molecular states should equal $2\pi \times$ (the frequency at which the maximum absorption occurs). The experiments thus provide a simple method of measuring the rate of interchange of energy in molecular collisions. J. E. R. C.

2676. Measurement of Sound Absorption. P. E. Sabine. *Acoustical Soc. of America, J.* 6. *pp.* 239–245, *April,* 1935.—In a recent series of measurements samples of the same material were measured in various testing laboratories. The wide divergences between the absorption coefficients so found are discussed and are ascribed to the varying volumes of the reverberation chambers used. It is suggested that, to secure better uniformity amongst the coefficients given, the different laboratories might try measuring samples the area of which is an agreed fraction of the total surface area of the respective reverberation chambers. J. E. R. C.

See also Abstracts 2344, 2350, 2351, 2352.

ELECTRICITY AND MAGNETISM.

ALTERNATING-CURRENT NETWORKS.

2677. Algebraic Structure of Admittances of a Filter as a Function of the Frequencies. J. Haag. *Comptes Rendus*, 200. *pp.* 1169–1172, *April* 1, 1935.—The quadratic impedance of a cell without ohmic resistance is investigated by the formula given in a previous paper [see Abstract 1763 (1935)]. A method is shown which gives the most general definition of the cell for the formula adopted for the impedance. By making certain conditions it is possible to construct a filter giving any zone of filtrage which is required. H. M. B.

CONDUCTION AND DISCHARGE IN GASES.

2678. Helium-Tungsten Arcs. O. Stübing. *Helv. Phys. Acta*, 8. 2. *pp.* 165–196, 1935. *In German.*—He-W arcs were examined in the pressure range 11–500 mm. to determine the relations between current, potential, arc length and pressure. By means of the current-potential curves for a tungsten probe a study was made of the behaviour of the primary electrons emitted by the kathode. The electron group with a volt velocity of the order of the kathode fall observed in nitrogen by Wehrli and Bächtiger at pressures below 29 mm. of Hg was found also in helium, but on account of the large mean free path in helium the group could be observed at pressures as high as 198 mm. As is to be expected on theoretical grounds, the total number of all elastically scattered electrons was found to decrease exponentially with increase of the product of pressure and distance from the kathode. The sudden disappearance of the anode fall on reduction of the arc length is also found in helium, but at much greater arc lengths than in the case of nitrogen. This effect was also observed when the pressure was decreased, keeping the arc length constant. A. W.

2679. Gas Discharge in the Cloud Chamber. H. Raether. *Zeits. f. Physik*, 94. 9–10. *pp.* 567–573, *April* 16, 1935.—The discharge from between (1) a ball-ended point and a plate, (2) a wire and a plate, situated in different gases is investigated as a function of the applied potential and polarity, with a cloud chamber. A supply condenser of 2000cm. capacity was used, the time constant through a parallel resistance of 20,000 Ω being about 4×10^{-5} sec. With the point at a distance of 1·5 cm. from the plate a streamer-like discharge occurs when a positive potential of 6 to 7 kV is reached. Photographs are reproduced showing the various effects up to a potential of 20 kV in air, water vapour, N_2 and CO_2. F. C. C.

2680. Momentum of Ions Leaving a Region of Ionisation. L. Tonks. *Phys. Rev.* 47. *pp.* 621–622, *April* 15, 1935.—The momentum carried by ions starting from rest in an ionised region and falling freely to an electrode differs from the electrostatic force on the collector not only by the electron pressure, but by an additional term which depends upon geometrical configuration, being zero in the plane parallel case. Expressions for the ion momentum are derived for the cases: cylinder, sphere, and cylindrical and spherical shell. The additional momentum is less

than, but of the same order of magnitude as corresponds to the electrostatic force and may be either positive or negative. The comparison has been worked out in two simple cases. [See Abstract 4284 (1934).]
AUTHOR.

2681. Negative Ions of Iodine. Part II. Ion Beams. J. S. Smith. *Phil. Mag.* 19. *pp.* 1016–1027, *May,* 1935.—It has been found possible to draw out from the discharge an intense beam of negative ions and to subject it to magnetic analysis. I^-, I_2^-, and I_3^- have all been found to be present, I_2^- being the commonest ion in the negative glow, whilst all three are present in approximately equal numbers in the positive column. A similar study of the positive ions established the presence of I^{++}, I^+, I_2^+, and I_3^+, I^{++} being absent from the positive column, and I_2^+ by far the most intense in all regions of the discharge studied. The probability of collision between electrons and negative ions of medium speed and neutral iodine molecules has been measured approximately. [For Part I see Abstract 2211 (1935).]
AUTHOR.

2682. Doubly Excited Helium Atom. H. Priestley and R. Whiddington. *Leeds Philosoph. and Lit. Soc., Proc.* 3. *pp.* 81–84, *April,* 1935.—Results are given for a second double-excitation process produced by electron impacts in helium, which has an associated energy value of 62·27 ± 0·39 eV. This value, and the one previously obtained by the authors [see Abstract 3372 (1934)] (of energy loss 59·25 ± 0·12 eV), are shown to agree quite well with the theoretical calculation of the energy levels of doubly-excited helium. An angular distribution curve is given for the $(2s2p)^1P$ excitation for small angles of scattering using electrons of 400 V energy, and is compared with experimental and theoretical 3^1P excitation distributions for electrons of the same energy. It is found that the double-excitation process decreases much less rapidly with increasing angle of scattering than does the 3^1P single excitation process, a result which agrees in principle with the theoretical results of Massey and Mohr.
AUTHORS.

2683. Collisions of Electrons with Nitrogen Molecules. R. Whiddington and E. G. Woodroofe. *Leeds Philosoph. and Lit. Soc., Proc.* 3. *pp.* 85–87, *April,* 1935.—The energy losses suffered by electrons in collision with nitrogen molecules have been re-determined. The losses observed were 8·95, 12·89, 13·81, and 15·91 volts and their interpretation in relation to spectroscopic data is briefly discussed. AUTHORS.

2684. Ionisation Area of He and Bethe's Theory. D. L. Webster, W. W. Hansen and F. B. Duveneck. *Phys. Rev.* 47. *p.* 699, *May* 1, 1935.—A correction. [See Abstract 3652 (1933).]

***2685. Modified Aston-Type Mass Spectrometer. D. D. Taylor.** *Phys. Rev.* 47. *pp.* 666–671, *May* 1, 1935.—A modified Aston-type mass spectrometer is described, in which ionisation is produced by controlled electron bombardment. The electric field used is radial, and the shape of the magnetic pole faces was calculated to give the necessary velocity focusing. A special type of filament assembly is employed to minimise the energy spread of the emitted electrons. An amplifier circuit is described using a Western Electric D-96475 tube which gives high sensitivity combined with good stability. A new device is described for giving a continuous indication proportional to the square of the magnetic field. Some preliminary results are included on the ionisation of N_2, CO, NH_3, N_2H_4.
AUTHOR.

2686. Chemical Decomposition of Silver Oxide by Slow Electrons. P. H. Wei, P. A. Anderson and Y. M. Hsieh. *Chinese Chem. Soc., J.* 3. *pp.* 6–15, *March*, 1935. *In English.*—A film of silver oxide, prepared by electrolytic oxidation of a silver film in sodium hydroxide solution was bombarded with electrons of energy up to 100 volts. No reduction of the oxide film was observed, the test being a decrease in the electrical resistance of the film. The effect may possibly be masked by an increase in resistance due to volatilisation of the film under the electron bombardment. F. C. C.

2687. Electric Arc with Liquid Positive Electrode. M. Pierucci. *N. Cimento*, 12. *pp.* 1–3, *Jan.*, 1935.—An arc is struck between a negative carbon electrode and a liquid contained in a carbon crucible. With a potential of 300 V the arc is quiescent even with a gap of several mm. if the negative electrode is drawn out to a point. The liquid was usually dilute sulphuric acid; it remained cold when the current density was low. Complete absence of a luminous positive crater is observed. If, however, the layer of liquid is shallow, the arc which then strikes through to the base of the crucible becomes enhanced and the liquid heats and rapidly evaporates. Spectroscopic examination shows that, proceeding from the negative electrode to the cold liquid, the spectrum which is initially continuous becomes a line spectrum exhibiting (with sulphuric acid present) the Balmer lines; inversion is frequent. All the lines become much intensified when the arc becomes enhanced. F. C. C.

***2688. Large Cloud Chamber. G. Herzog.** *Journ. Sci. Instruments*, 12. *pp.* 153–159, *May*, 1935.—The construction and behaviour of a cloud chamber of internal dimensions 50 cm. × 25 cm. is given in detail. It has its plane arranged vertically and is of the type recently described by Wilson [see Abstract 5016 (1933)], except that no rubber diaphragm is used. Many straight tracks 50 cm. long have been obtained; the tracks were found to have a breadth of 0·18 mm. on the photographic plate, which compared to a real track breadth of 2·2 mm. With 8 volts per cm., a separation of 6·4 mm. was found between the positive and negative ions. AUTHOR.

***2689. Automatic High-Pressure Cloud Chamber. W. M. Brubaker and T. W. Bonner.** *Rev. Sci. Instruments*, 6. *pp.* 143–145, *May*, 1935.—An automatic high-pressure cloud chamber of working volume 9 cm. dia. by 4 cm. deep and using sylphon principles is described. Illumination provided by a 2000W kinematograph flood-lamp proved sufficient for recording electron and proton tracks when a camera with *f*/3·5 aperture and superpanchromatic film were used. Photographs are reproduced of recoil protons from the neutrons produced in the disintegration of Be by deutons, passing through CH_4 at pressures of 10·5 and 5·87 atmospheres respectively. F. C. C.

See also Abstracts 2510, 2521, 2558, 2560, 2639, 2640, 2642, 2734.

CONDUCTION IN SOLIDS AND LIQUIDS.

2690. Number of Free Electrons in a Metal. H. Fröhlich. *Cambridge Phil. Soc., Proc.* 31. *pp.* 277–280, *April*, 1935.—A note showing that a simple expression for N_F, the number of free electrons in a metal, can be obtained from the general theoretical model of a metal without making special assumptions concerning the potential field in the metal. The result of the calculation leads to the formula $N_F = \frac{4}{3} D(\zeta) E_{kin}(\zeta)$ where ζ is the

Fermi energy, $D(\zeta)$ is the density of quantum states for the energy ζ (without consideration of spin), and E_{kin} is the average kinetic energy of those electrons whose total energy is ζ. R. L.

***2691. Vibration Galvanometer. H. A. Vuylsteke.** *R.G.E.* 37. *pp.* 537–539, *April* 27, 1935.—A modification of the Campbell galvanometer having variable electromagnetic control, which is secured by the use of a second moving coil with its own magnet, which may be an electromagnet. The two coils are rigidly connected together on a common suspension and turn about a common axis. D.c. is passed through the auxiliary coil, which is set with its plane perpendicular to the direction of the magnetic field in which it is placed, so that when the moving system is deflected it is acted upon by a restoring force proportional to this d.c. and the magnetic field. Thus the tuning of the suspended system may be controlled by the current in the auxiliary coil, or in the associated electromagnet. It is shown that the resonance-frequency may be made proportional to the auxiliary current, and the instrument then used as a frequency meter. L. H.

***2692. Amplification of Galvanometer Deflections. E. B. Moss.** *Journ. Sci. Instruments*, 12. *pp.* 141–148, *May*, 1935.—A general review of the methods now available for the amplification of galvanometer deflections, including thermal relays, and photo-cell relays, with photo-cells of both the rectifier and emission types. Some practical details are included. L. H.

2693. Crystal Rectification. S. R. Khastgir and A. K. Dasgupta. *Indian Journ. Phys.* 9. *pp.* 255–276, *March*, 1935.—The results of experiments described in the paper lead the authors to believe that there are two different kinds of rectification, point rectification and volume rectification, the latter being independent of any point effect and attributed to asymmetry in the crystal structure. Theoretical explanations are to be given in a subsequent paper. R. L.

2694. Asymmetrical Conductivity of the Electrode System Metal—Layer of Salt—Adsorbed Alkali Metal. J. H. de Boer and W. C. van Geel. *Physica*, 2. *pp.* 309–320, *April*, 1935. *In German.*—An account is given of measurements of the characteristic curves of electrode systems of the type metal—layer of salt—adsorbed alkali metal (Ag-CaF_2-Cs), which show asymmetrical conductivity. The alkali metal shows marked " action of points," which gives rise to an intense field and makes the cold electronic emission from this metal greater than that from the other metal. The phenomena are complicated by the formation of conducting bridges in the layer of salt, whereby the asymmetry of conductivity is temporarily removed. [See following Abstract.] L. A. W.

2695. Asymmetrical Conductivity of the Combination Metal-Blocking Layer—Layer of Salt—Adsorbed Alkali Metal. W. C. van Geel and J. H. de Boer. *Physica*, 2. *pp.* 321–327, *April*, 1935. *In German.*—Electrode systems of the type metal—blocking layer—layer of salt—adsorbed alkali metal (*e.g.* Ag-shellac-CaF_2-K) show asymmetrical conductivity. With the alkali metal negative the current i and the voltage V are found to be related by the equation $i = KV^{3/2}$, whereas with the alkali metal positive the relationship is $i = Ae^{-B/V}$. The conductivity is due to cold electronic emission. The layer of insulator (shellac, resin, phosphorus or sulphur) is introduced with the object of preventing the formation of conducting bridges. Such bridges are formed, however, in the layer of salt, causing temporarily symmetrical conductivity. [See preceding Abstract.] L. A. W.

2696. Magnetic Properties and Critical Currents of Supraconducting Alloys. J. N. Rjabinin and L. W. Schubnikow. *Phys. Zeits. d. Sowjetunion,* 7. 1. *pp.* 122–125, 1935. *In English.*—Results obtained in an investigation into the magnetic properties of two supraconducting alloys are summarised. The alloys studied are one corresponding to $PbTl_2$ and one containing 65 % Pb and 35 % Bi. Similar results are obtained in the two cases. Up to a definite critical field-strength H_1, which depends on the temperature, the induction B remains nearly zero. The induction increases with further increase in field-strength and at H_2, which also depends on temperature, the metal loses its supra-conductivity. The critical electric current—the current which destroys supraconductivity—is also measured for wires of $PbTl_2$ having diameters of 0·71, 0·33 and 0·26 mm., and the field strength H_3, which this current produces calculated. When H_3 is plotted against temperature the values all lie in one line, and it is seen that H_3 is always less than H_1. R. W. P.

2697. Supraconductivity and Diamagnetism. F. and H. London. *Physica,* 2. *pp.* 341–354, *April,* 1935. *In German.*—In contrast to the usual conception that a current may persist in a supraconductor without the necessity for an electromagnetic field, it is shown that the current may be regarded as a type of diamagnetic volume current which requires the presence of a magnetic field for its existence. The current itself may give rise to the field. The co-existence of supraconducting and normally conducting electrons in a supraconductor is postulated. H. J. H. S.

2698. Migration Velocity of Electronic Colour Centres in Crystals. S. Arzybysev. *Phys. Zeits. d. Sowjetunion,* 7. 1. *pp.* 120–121, 1935. *In German.*—In answer to Frenkel [see Abstract 1798 (1935)] reference is made to the experimental results obtained by Stasiw and Smekal. The former has shown that as migration proceeds the concentration of the colour centres decreases, and the latter that the electronic and ionic currents are of the same order for the crystals and temperatures concerned. Both results are at variance with the assumptions made in Frenkel's theory. R. W. P.

2699. Velocity of Migration of Kations in Crystals of Alkali Halides. O. Stasiw. *Göttingen Nachrichten, Fachgruppe II.* 1. 12. *pp.* 147–152, 1935.—In these crystals the mobility of the electrons has been measured by (1) observation of a cloud of colour-centres in the field, and (2) simultaneous observations of the current strength and the number of colour centres, measured optically, in a crystal filled with the centres [see Abstract 4312 (1934)]; the results given by the two methods agree satisfactorily. In other crystals the mobility of the electrons has been determined only indirectly with the aid of the Hall constant H. Attempts to apply the last method to KBr have revealed an unforeseen source of error, due to the fact that the magnetic field alters the distribution of the colour-centres in the crystal and thus gives rise to a concentration element between the Hall electrodes. It is found that the mobility of the positive charges increases exponentially with rise of temperature and at 600–700° C. becomes equal to that of the electrons. This equality of the mobilities of the two partners of the colour-centres—the alkali kations and the electrons—does away with the braking effect of the positive charges on electron migration and so renders clear the high velocity of diffusion of the colour centres in hot crystals. T. H. P.

2700. Electron Conduction in Crystals of Silver and Thallium Halides. W. Lehfeldt. *Göttingen Nachrichten, Fachgruppe II*, 1. 14. *pp*. 171–186, 1935.—In TlBr crystals the phenomena of the photoelectric primary current may be produced at —70° C., just as in AgCl crystals at —170° C. With a sufficiently intense field, all the electrons split off by the light pass to the anode, the positive charges persisting. Hence in these crystals definite statements may be made concerning the thrust-path of the electrons split off and their quantum yield may be measured electrically. In the region of the high ultra-violet absorption this yield is 0·1 – 0·5. Crystals with long thrust-paths of the electrons in the photoelectric primary current show at the same time a marked inclination to the development of the secondary current, in which electrons pass from the kathode into the crystal and migrate to the anode. The dependence of this secondary current on temperature has been determined over the range 0° to —258° C. T. H. P.

2701. Conductance of Electrolytes in Anisole, Ethylene Bromide, and Ethylene Chloride at 25°. N. L. Cox, C. A. Kraus and R. M. Fuoss. *Faraday Soc., Trans*. 31. *pp*. 749–761, *May*, 1935.—Several sources of error affecting conductance measurements with solutions in solvents of low dielectric constant and at low concentrations have been investigated and means have been devised to eliminate or minimise them. The conductance of a number of quaternary ammonium salts has been measured in ethylene chloride, ethylene bromide and anisole as solvents. Values reproducible within 0·1 to 0·2 % have been obtained at concentrations of the order of 10^{-6} *N*. The experimental values are in accord with the ion association theory, as developed by Fuoss and Kraus, within the limit of experimental error. The constants of the association equilibria have been evaluated and ion dimensions have been computed therefrom. The dimensions so found are in reasonably good accord with atomic dimensions. AUTHORS.

2702. Structure and Electrical Conductivity of Ceramic Diaphragms. J. Velišek and A. Vašiček. *Kolloid Zeits*. 71. *pp*. 36–48, *April*, 1935.—Results are given of measurements of the resistance of ceramic diaphragms P_1, P_{10} and P_{28b} of the Berlin State Porcelain Factory. For constant thickness, the conductivity is directly proportional to the surface. With constant area, however, the resistance is proportional to the thickness only for the P_1 diaphragm, which is a typical normal diaphragm. The P_{10} and P_{28b} diaphragms, with which the resistance at first increases more rapidly than the thickness and shows linear increase only beyond a certain thickness (1mm.), are typical abnormal diaphragms. In these cases the resistance varies in the surface layers and becomes constant only at a certain depth. The surface layers seem to possess a fine structure and the remainder a coarser structure. To the normal diaphragm P_1, which has an immeasurably thin surface layer, a very fine structure is ascribed. The influence of the space lattice of the capillaries on the resistance or conductivity of the diaphragm is discussed. T. H. P.

See also Abstracts 2625, 2704, 2719, 2746.

DIELECTRICS AND CAPACITANCE.

2703. Effect of Hydrogen Bond on Dielectric Constants and Boiling Points of Organic Liquids. W. D. Kumler. *Am. Chem. Soc., J*. 57. *pp*. 600–605, *April*, 1935.—A method has been devised to determine the effect of molecular interaction on the dielectric constants of liquids. Liquids that do not form bonds have normal dielectric constants, those that form hydrogen bonds have abnormal dielectric constants. The conditions necessary for hydrogen bond formation are formulated. The structures of the association complexes in the liquid state of the carboxylic acids, HF and HCN are discussed. A scheme is used to show the effect of hydrogen bonds on the boiling points of organic liquids. It is found that such bonds raise the boiling points of the liquids considered, by an average of 76°. The molecular weights of acetamide, monoethylacetamide and diethylacetamide were measured. The connection between hydrogen bond formation and resonance in amides is discussed. AUTHOR.

2704. Glass as a Dielectric. G. W. Morey. *Frank. Inst. J.* 219. *pp.* 315–330, *March,* 1935.—A survey of the literature relating to the electrical properties of glass. The properties considered are surface and volume resistivity ; dielectric constant ; absorption currents, and residual charge ; power loss under alternating voltage. Data are collected showing the variation of these properties with such factors as chemical composition, temperature, relative humidity, and frequency. L. H.

***2705. Time Development of Dielectric Constant of Rochelle Salt. H. Goedecke.** *Zeits. f. Physik,* 94. 9–10. *pp.* 574–589, *April* 16, 1935.—An arrangement is described whereby the characteristic of the charge and discharge of a Rochelle salt condenser for times down to $3 \cdot 10^{-7}$ sec. was measured. The characteristics showed that three groups of charge carriers were in action consecutively. The first group, effective already at 10^{-6} sec., probably gave an electronic polarisation. The second, predominant between 10^{-6} to 10^{-4} sec., corresponded apparently to polarisation by ionic movement. Finally, after 10^{-4} sec. the dipole group appeared which was the main cause of the high dielectric constant. Kathode ray oscillograms, by which the relation of charge to intensity at high frequencies was investigated, confirmed the results. A. M.-T.

***2706. Dielectric Constants of Gases and Vapours. M. Kubo.** *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 564. *pp.* 242–257, *March,* 1935. *In English.*—An apparatus for the accurate determination of the dielectric constants of gases and vapours, similar to that employed by Zahn, was constructed and tested by measurements on CO_2 and air. The dielectric constants of pentane, hexane, heptane, methyl alcohol, ethyl alcohol, isopropyl alcohol, and isobutyl alcohol were measured, and were used to calculate their atomic polarisations and electric moments. Debye's linear relation of molecular polarisation to the reciprocal of absolute temperature is well fulfilled, though the molecules of some of the alcohols examined have one axis of free rotation or two. The molecule of isopropyl alcohol (a secondary alcohol) has a smaller electric moment than the other three (primary) alcohols. The electric moments of the alcohols measured by other observers in benzene and ether solution are larger than those obtained in gaseous state. J. J. S.

2707. Dielectric Constants of Air and Hydrogen at High Pressures. R. McNabney, W. Moulton and W. L. Beuschlein. *Phys. Rev.* 47. *pp.* 695–698, *May* 1, 1935.—The dielectric constants of air and hydrogen at pressures from 71·8 to 334·7 atmospheres at 20° C. have been measured. The values were obtained by measuring, with a capacity meter of the heterodyne type, the variation with pressure of the capacity of a fixed condenser fitted into the pressure vessel. The frequency was 2500 kc. The dielectric constants obtained are slightly lower than those of Tangl and Broxon for pressures about 80 atmospheres. The Clausius-Mossotti function $(\epsilon - 1)/d\ (\epsilon + 2)$ was calculated for each pressure. The change with pressure for air is small and irregular, average 1·43. For hydrogen the value decreased uniformly from 1·16 at 71·8 atmospheres to 0·99 at 334·7 atmospheres. AUTHORS.

***2708. Dielectric Constants of Electrolytes. R. W. McKay.** *Canad. J. of Research*, 12. *pp.* 377–397, *March*, 1935.—An apparatus for measuring the dielectric constant of conducting solutions by voltage resonance is described. The theory of the circuit and the sources of error are discussed. The design of the apparatus is such as to eliminate errors other than those due to inductance of cell leads, for which a correction is made. Measurements have been made on solutions of sodium chloride, hydrogen chloride, potassium sulphate, magnesium sulphate, copper sulphate and potassium ferrocyanide, at 23·0° C. and 2×10^6 cycles frequency. An increase in dieletric constant with concentration greater than that predicted by Debye and Falkenhagen has been found in all cases. The results are compared with those of other workers. Graphs are given of the results obtained. AUTHOR.

2709. Saturation Effect of the Dielectric Constants of Electrolytes. W. Hackel. *Phys. Zeits.* 36. *pp.* 220–222, *April* 1, 1935.—The existence and magnitude of the saturation effect of the dielectric constant of solutions LiF and KCl were investigated. According to theory, the dielectric constant increases with $\sqrt{m}$ (m = concentration) owing to the ionic cloud effect, but tends also to decrease with increase of m due to the saturation effect. The theory is applicable only to very dilute solutions. Measurements of the dielectric constants of the dilute solutions were made by a barretter method with special electrodes. The latter had a small hole in the centre through which passed a capillary tube, which could be filled with salt solution so that the resistance of the test condenser was always the same. The saturation effect should be independent of frequency, and measurements were made with wave-lengths of 30 m. The saturation effect in solutions of about 1–2 mol. per l. was found to be inappreciable, in any case less than 1 in 1000. The difference between the effects with LiF and KCl was less than 0·5 in 1000. A. M.-T.

2710. Dielectric Properties of Acetylenic Halides and Alcohols. J. A. Toussaint and H. H. Wenzke. *Am. Chem. Soc., J.* 57. *pp.* 668–670, *April*, 1935.—The electric moments of the acetylenic halides are influenced by the position of the triple linking, the influence being least with the chloro- and greatest with the iodo-compounds. The moments of the acetylenic alcohols are higher than those of the normal aliphatic alcohols; the inductive effect is felt even when there are two C atoms between the acetylenic C atom and the OH group. The values of the electric moments for a number of compounds are recorded. T. H. P.

2711. Calculation of Dipole Moments. I. R. Kritschewsky and J. S. Kasarnowsky. *Zeits. f. phys. Chem.* 28. *Abt.B.* 6. *pp.* 461–477, 1935.—The modification of the thermodynamic equation of the thermal effect by introduction of a dielectric into the electrostatic field in the statistical equation, enables the values of dipole moments to be calculated. The derived equation has been tested for pure substances and gives good results for polar liquids of small dielectric constant in contrast to the Debye-equation. In the calculation of dipole moments by the method of diluted solutions, the derived equation is found to be particularly useful in cases of anomalous polarisation-temperature phenomena.

Equations are derived which enable the volume and dielectric constant of a solution to be extrapolated to infinite dilution. H. H. Ho.

2712. Dipole Moments of Associated Liquids. F. R. Goss. *Chem. Soc., J. pp.* 502–506, *April*, 1935.—The differences observed between the dielectric polarisation of liquids and gases are attributed mainly to decreases due to the anisotropy and the association of the solvent, and to an increase due to the association of the solute. A formula for the polarisation of liquids is deduced and exemplified by reference to the behaviour of nitrobenzene in various solvents. AUTHOR.

2713. Association and Molecular Polarisation. C. Hennings. *Zeits. f. phys. Chem.* 28. *Abt.B.* 4. *pp.* 267–289, 1935.—The orientation polarisation curves of methyl, ethyl, *n* and *iso* propyl, *n* and tertiary butyl alcohols in hexane and in benzene at 7° and 30° C. are discussed. In this way it is possible to draw conclusions regarding the degree of association of the alcohols in relation to the length of the chain, the branching of the chain, solvent, and temperature. Additional evidence was obtained by consideration of the heat of mixing of these alcohols with hexane and benzene, and by determinations of density and molecular weight. Sources of error in determining dipole moments of dilute solutions are discussed. The moments of *iso* propyl alcohol and *tertiary* butyl alcohol are respectively $1 \cdot 63$ and $1 \cdot 55 \times 10^{-18}$ e.s.u. Dielectric constants of the alcohols at 7° C. and 30° C. are recorded. **Errata, 28.** *Abt. B.* 6. *p.* 480, 1935. W. R. A.

2714. Two Types of Dielectric Polarisation. S. O. Morgan. *Am. Electrochem. Soc., Trans.* 65. *pp.* 109–116; *Disc.*, 116–118, 1934.—The paper begins with a discussion of the types of anomalous dispersion due to dipoles and to heterogeneous mixtures. Anomalous dispersion at any frequency between power frequencies and high radio frequencies may be produced by changes of the viscosity of a polar liquid, and by changes of the relative capacitances and conductances of the components of heterogeneous liquids. The experimental results given appear to indicate that glycerin is a polar liquid, and that halowax and dried condenser paper are non-polar, but heterogeneous. W. H. W.

2715. Anomalous Dispersion in Crystalline Solids. Cheng E. Sun and J. W. Williams. *Am. Electrochem. Soc., Trans.* 65. *pp.* 121–131, 1934.—The experimental procedure is described for the measurement of the dielectric constants of crystalline benzene, nitrobenzene, benzophenone, acetophone and ammonia at various temperatures, and at frequencies from 300 to 600,000 ∼. Benzene was found to have no anomalous dispersion and ammonia but little; the remainder of the materials showed considerable anomalous dispersion. Polar molecules, or groups of molecules, are shown to be a probable explanation, but the possible influence of the accumulation of ions at the electrodes, of the movement of ions in or along crystal imperfections, and of conducting impurities cannot be disregarded. W. H. W.

2716. Polarisation in Ice. E. J. Murphy. *Am. Electrochem. Soc., Trans.* 65. *pp.* 133–142; *Disc.*, 142, 1934.—The only test by which the anomalous dispersion due to polar molecules may be differentiated from that due to other sources is that, for a polar substance, the polarisability measured at zero frequency is proportional to the reciprocal of the absolute temperature. Measurements made on ice at varying frequencies, and by a ballistic method, give a somewhat uncertain indication of such a proportionality. At temperatures down to − 139° C. the abrupt decrease of dielectric constant, which follows from Pauling's theory of molecules free to assume any orientation within the crystal lattice without doing work, was not found. W. H. W.

✱2717. Anomalous Dispersion of Lecithin in Viscous Mineral Oils. A. L. Ferguson, L. O. Case and G. H. Evans. *J. Chem. Phys.* 3. *pp.* 285–290, *May,* 1935.—A unique receiver and accompanying cell for determining dielectric constants by the resonance method were constructed. Their design is such as to reduce to a minimum several types of error inherent in the resonance method. Dielectric constant measurements were made on five solutions of lecithin in very viscous mineral oils at three temperatures and at six wave-lengths. Three distinct methods were employed: (1) refractometer method—frequency of D line of sodium, (2) resonance method—32·8 m., 94 m., 320 m., 1308 m., (3) bridge method —precision Wheatstone bridge, 1036 cycles. Analyses of the experimental curves and comparisons with theoretical Debye curves definitely indicate dispersion though not of a simple type. Another series of measurements made on one solution at 16 different wave-lengths covering the range from 40 m. to 5,000,000 m. still failed to show any individual simple dispersion regions. A qualitative explanation based on varying viscosities of the components of the solvent, the presence of polar radicals in the solute molecules, and the extensive association of the solute is offered. AUTHORS.

2718. Behaviour of Dielectrics under Alternating Stress. G. M. L. Sommerman. *Frank. Inst., J.* 219. *pp.* 433–458, *April,* 1935. —The power factor of a non-polar solid (paraffin) alone and containing 3 % phenol was determined for a frequency range 65 to $7 \cdot 2 \times 10^6 \sim$ and a temperature range 2·9° C. to 90° C. Power-factor maxima due to molecular orientation (dipoles) were found appreciable only at frequencies above 10^7 cycles. Adding 10 % stearic acid gave similar results. It was concluded that the maxima do not shift to lower frequencies at lower temperatures owing to the inner viscosity increasing only to a very small extent in the solid state. The inner viscosity was calculated from the reciprocals of the short-time conductivities. The solvent alone gave very small power-factor maxima (0·0003) which shifted over the audio-frequency range with temperature variation. This effect was considered due to associated or polymerised polar aggregates of such size as to be affected by the larger macroscopic viscosity changes. In the amorphous solid state the limited motion of ions gave an ionic polarisation, as deduced from absorption curves and the high power factors at low frequencies and these effects were increased by addition of organic acids. The true short-time conductivity was caused mainly by dissociated inorganic material. A. M.-T.

2719. Insulation Characteristics of Amber, Quartz, and Sulphur in Dry and Damp Air. W. Gnann. *Phys. Zeits.* 36. *pp.* 222–230, *April* 1, 1935.—Determinations of the insulation resistance and absorption current were made on amber, quartz, and sulphur in dry and moist air. Various shapes of samples were also investigated. The measurements were made with field strengths of 100 to 2000 V/cm. at room-temperatures. The results are reported in detail. When dry, amorphous quartz has similar properties to amber, but moist air causes a much greater deterioration with the former. Sulphur is superior to the other materials under moist conditions. Under dry conditions the volume resistivity of amber was found to be of the order 10^{20} ohms. cm. for maintained d.c., falling to 10^{15} at 90° relative humidity. For quartz the values were approximately 10^{20} and 10^{12} respectively. Moisture has little effect on the absorption current for amber. For sulphur the values were 10^{19}–10^{18} with inappreciable change in moist air. Rough estimates of the density and mobility of the ions present in amber were made, viz., 10^7/cm.^{3} and 10^{-8} to 10^{-9} cm./sec. respectively. A. M.-T.

2720. Measurement of Short-Wave Absorption in Dipole Liquids. J. Malsch and E. Keutner. *Phys. Zeits.* 36. *pp.* 288–292, *April* 15, 1935.—Determination of the absorption of short waves (0·5 m. to 10 m.) were made on alcohols by a special method due to Haas [see Abstract 2630 (1934)]. According to this method the absorbed energy in a dipole liquid for a definite time is measured by the increase of temperature, the total current being maintained constant. It was found that the absorbed energy was independent of the wave-length within the limits of accuracy of the measurements. The method is very suitable for verification of Debye's equation and also for the determination of relaxation times. The results were not in agreement with those of Haas and Krause but were in accordance with Debye's dipole theory. A. M.-T.

2721. Mechanism of Dielectric Loss in Paraffin Wax Solutions at High Radio Frequencies. W. Jackson. *Roy. Soc., Proc.* 150*A*. *pp.* 197–220, *May* 1, 1935.—The paper describes a study at high radio frequencies of the mechanism of power loss in a paraffin wax medium containing small percentages of impurities of known chemical composition. Major attention is given to the results on solid solutions of an ester, cetyl palmitate, in the wax. It is shown that the variation of power loss with both frequency and temperature is in good quantitative agreement with the Debye theory of dielectric absorption, in spite of the fact that the physical concepts on which this theory is based seem quite unsuited to the solid state. It is found that the "apparent viscosity" of the solid paraffin wax medium to the orientation within it of polar molecules is only of the order of the viscosity coefficient of a liquid such as castor oil. Analysis of the temperature variation of this inner viscosity, and comparison with viscosity values obtained experimentally for the molten material, lead to the conclusion that only a portion of the polar cetyl palmitate molecule oscillates in the alternating electric field. Finally the applicability of the Debye theory to the results is substantiated by the evidence of dielectric constant and conductivity measurements. AUTHOR.

See also Abstracts 2338, 2339, 2371.

ELECTROCHEMISTRY.

2722. Activity Coefficients and Osmotic Coefficients of Strong and Weak Electrolytes. P. van Rysselberghe. *J. Phys. Chem.* 39. *pp.* 403–414, *March*, 1935.—Three thermodynamic descriptions of solutions of electrolytes corresponding respectively to an undissociated, a completely dissociated, and an incompletely dissociated solute have been studied. Between the three sets of activity and osmotic coefficients certain thermodynamic relations are shown to hold. These are obtained in general form, and some interesting simple formulæ are deduced for the particular case of very low concentrations and that of very weak electrolytes. AUTHOR.

2723. Activity and Osmotic Coefficients of Aqueous Solutions of Acetic Acid at the Freezing Point. P. van Rysselberghe. *J. Phys. Chem.* 39. *pp.* 415–419, *March*, 1935.—The various activity and osmotic coefficients corresponding to the three thermodynamic descriptions (undissociated, completely dissociated, incompletely dissociated solute) for aqueous solutions of acetic acid are deduced from the best available freezing point data. The value $1 \cdot 653 \times 10^{-5}$ of the dissociation constant at 0° C., determined by Harned and Ehlers, is used. The activity coefficients are obtained without the usual graphic extrapolation to infinite dilution, thanks to the combined use of the dissociation constant, of the Debye-Hückel limiting law, and of an empirical relation giving the dependence of the Lewis-Randall deviation function on molality. AUTHOR.

2724. Virial Theorem and the Theory of Strong Electrolytes. B. N. Finkelstein. *Cambridge Phil. Soc., Proc.* 31. *pp.* 281–284, *April,* 1935.—Since Fowler's work on the statistical foundations of the Debye-Hückel theory of strong electrolytes various attempts have been made to obtain information regarding the equation of state of electrolytes from merely thermodynamic and dimensional considerations. It is demonstrated that, contrary to van Rysselberghe's view [see Abstract 2591 (1933)] the virial theorem does not constitute an independent relation, but must be regarded as a simple corollary to the general thermodynamical and dimensional reasoning. By employing throughout the thermodynamical method, a uniform presentation is developed for certain results obtained by Fuoss [see Abstract 4887 (1934)]. T. H. P.

2725. New Experiment in Electrolysis. P. Jolibois. *Comptes Rendus,* 200. *pp.* 1469–1470, *April* 24, 1935.—If a Pt anode is plunged in $CuSO_4$ aq., in a vessel which is connected with a second similar vessel by a reversed syphon, and a Pt kathode is placed about 1 mm. above the surface of the solution in this second vessel, and a p.d. of about 350 V is maintained, a spark passes and $Cu(OH)_2$ is precipitated in the second vessel. If $AgNO_3$ replaces $CuSO_4$, AgO is similarly formed. It is inferred that the current decomposes both H_2O and the dissolved salt, but that the high p.d. causes the removal of the H formed so quickly that it has no time to reduce the metallic oxide. [See Abstract 5217 (1934).] C. A. S.

2726. Determination of Ionic Activities. S. v. Náray-Szabó and Z. Szabó. *Zeits. f. phys. Chem.* 173. *Abt.A.*2. *pp.* 103–105, 1935. It is shown that for the determination of coefficients of ionic activities from e.m.f. measurements of concentration cells, an accuracy of at least 0·1 mV is necessary while the diffusion potentials must also be taken into account. H. H. Ho.

2727. Temperature Variation in Transference Numbers of Concentrated Solutions of Sulphuric Acid. W. J. Hamer. *Am. Chem. Soc., J.* 57. *pp.* 662–667, *April,* 1935.—Measurements of the e.m.f. of the cell $Hg \mid Hg_2SO_4 \mid H_2SO_4\ (m) \mid H_2SO_4\ (m_1) \mid Hg_2SO_4 \mid Hg$ have been made over a concentration range of 0·05 – 17·0 mol. and at temperatures between 0° and 60° C. From the results obtained, together with those found for a cell without liquid junction by Harned and Hamer [see Abstract 1822 (1935)], the transference numbers of the H-ion of H_2SO_4 are calculated for the above ranges of temperature and concentration by means of the Rutledge equation for the derivative determination. Considerations involved in the applicability of the galvanic cell method to very concentrated solutions of H_2SO_4 are discussed. Extrapolations of the kation transference numbers of H_2SO_4 to zero concentration and the limiting law, based on the Debye-Hückel-Onsager conductance equations, are given for various temperatures. T. H. P.

2728. Potential Formation in a Solution of Foreign Ions. O. Essin and T. Beklemyschewa. *J. Phys. Chem.* 39. *pp.* 371–375, *March,* 1935.—In addition to the preceding measurements [see Abstract 1310

(1934)] of the potential of gold in solutions of copper and silver salts, the potentials of silver in solutions of copper sulphate and copper nitrate were measured. The dependence (deduced earlier on the basis of the adsorption theory for such potential) between the potential and the activity of the selectively adsorbed ions, proved on the potential of gold, was confirmed by the potential of silver and by the experimental data of A. Schmid and his collaborators (the potential of copper in the halogen solutions of alkali metals). AUTHORS.

2729. Theory of Electrical Excitation in Electrolytes. M. Planck. *Zeits. f. Physik,* 94. 7–8. *pp.* 469—472, *April* 8, 1935.—The problem is investigated as to whether cases exist in which the spatial free charge density in an electrolyte is so great that the concentrations of the neighbouring charged ions may be regarded as no longer equal throughout. As a solution, the author finds that so long as the concentrations can be treated as continuous, the difference of two concentrations can always be neglected. H. H. Ho.

2730. Hydration of the D^+ Ion in Heavy Water and Dissociation of the Deutero-acids. P. Goldfinger and W. Jeunehomme. *Comptes Rendus,* 200. *pp.* 1387–1389, *April* 15, 1935.—The hydration of ions and the dissociation of acids consist, on one hand, of electrostatic actions due to the molecules of the solvent, the free energy of which is about 0·05 Cal. smaller in D_2O than in H_2O. On the other hand, the ion may form molecules with the solvent; the resultant free energy is the greater in D_2O, the difference amounting to 1 Cal. for the molecule D_3O^+. A difference of the same order of magnitude appears in the free energy of the linking of H and D in acids and deutero-acids. These differences apparently originate mainly in the difference between the zero energies. T. H. P.

2731. Influence of Ionic Environment on the Dissociation of Weak Electrolytes. H. M. Dawson. *Leeds Philosoph. & Lit. Soc., Proc.* 3. *pp.* 88–91, *April,* 1935.—The dissociation of acetic acid in NaCl solutions has been examined by the author by two independent kinetic methods and the results are compared with those derived from two series of potentiometric measurements. The general character of the results is the same in all cases in that the dissociation constant K_c passes through a maximum when the solution is approximately 0·5 *N* in respect of the NaCl. The relative values of K_c at the different salt concentrations suggest that the kinetic methods provide the more consistent results for the influence of ionic environment. AUTHOR.

See also Abstract **2332.**

ELECTRONS, POSITRONS AND PROTONS, INCLUDING APPLICATIONS.

2732. Diffraction of Electrons by Single Crystals. O. Specchia and N. Dallaporta. *N. Cimento,* 12. *pp.* 4–14, *Jan.,* 1935.—Diffraction patterns produced by electrons of 50,000 V energy incident upon crystals of mica, gypsum, NaCl and calcite are reproduced. Good agreement between experiment and wave-mechanical theory is obtained on the assumption that while electrons with an angle of incidence greater than that required for Bragg reflection transfer energy to the crystal, those with an angle of incidence less than that required for regular reflection receive energy from the crystal. F. C. C.

2733. Diffraction of Kathode Rays by Single Crystals. K. Shinohara. *Phys. Rev.* 47. *pp.* 730–735, *May* 15, 1935.—The black and white line parabolæ and circles observed in the diffraction patterns of electrons are shown to be a kind of envelope of the family of Kikuchi lines due to a set of co-zonal planes. That the parabolæ appear isolated from the generating Kikuchi lines is due to an effect similar to that which in the case of X-rays accounts for the reduction in density observed at the intersection of two lines in the diffraction pattern. The circle is in fact the envelope of a family of parabolæ, its appearance isolated from the generating lines being accounted for in the manner mentioned above. It is shown that the circle is the boundary of a region within which occur no Kikuchi lines of a certain set. AUTHOR.

2734. Theory of the Refractive Index of Crystals for Kathode Rays and the Breadth of Reflection Line. S. Kikuchi. *Inst. Phys. & Chem. Research, Tokyo, Sci. Papers, No.* 563. *pp.* 225–241, *March*, 1935. *In English.*—A mathematical paper in which the following are dealt with: (1) The solution of the wave equation in a crystal; (2) The Bragg's case; (3) The reflecting power; (4) The breadth of reflection line and the refractive index. Comparison is made with results of experiment. J. J. S.

2735. Scattering Absorption of Electron Rays. A. Recknagel. *Zeits. f. Physik*, 94. 5–6. *pp.* 356–360, *April* 2, 1935.—Bothe has given a method, based on classical mechanics, for calculating the mass absorption coefficient for electrons. Considering only elastic scattering and using the theory of Thomas and Fermi, the authors modify the Bothe formula. The modification results in a smaller value for the mass absorption coefficient than that deduced by the Bothe formula, thus giving a closer agreement between calculated and observed values of the coefficient. H. J. H. S.

2736. Production of Protons by Bombardment of Palladium with Electrons. R. Kollath. *Zeits. f. Physik*, 94. 5–6. *pp.* 397–407, *April* 2, 1935.—The phenomenon of the production of protons by the bombardment of Pd containing adsorbed H_2 has been investigated by Sugiura [see Abstract 3928 (1931)]. Here the mechanism of the phenomenon is investigated. The relative intensity of proton emission compared with that of the simultaneous emission of H_2^+ ions is markedly dependent upon the number and velocity of the incident electrons, and upon their accelerating potential. The ratio is not in any marked degree dependent upon the pressure of the H_2 on the face of the Pd facing the source of electrons. The absolute intensity of proton emission is increased by raising the temperature of the Pd and by increasing the number of electrons incident upon it. The energy of the protons is not uniform and its maximum value corresponds to 70–75 % of the applied accelerating potential. The protons are produced by electron impacts in an atmosphere of hydrogen. J. S. G. T.

2737. Scattering of Protons on Protons. W. H. Wells. *Phys. Rev.* 47. *pp.* 591–596, *April* 15, 1935.—A technique for obtaining large numbers of high energy proton-tracks in hydrogen with a Wilson cloud chamber is described. The recoil-particles from cellophane bombarded by Po α-particles were used as a source of protons. The velocity distribution of a sample of 500 protons is given. Over 15,000 stereoscopic views containing above 200,000 tracks of protons in a 90 % hydrogen-10 % air mixture have been obtained. Of the 33 intimate proton-proton collisions two were within the region of anomalous scattering of α-particles by hydrogen. The closest distance of approach realised experimentally was $6 \cdot 1 \times 10^{-13}$ cm. AUTHOR.

2738. Production of Positrons in Various Elements. S. de Benedetti. *Comptes Rendus,* 200. *pp.* 1389–1391, *April* 15, 1935.—An arrangement is described, based on Thibaud's trochoid method [see Abstract 3020 (1934)], whereby the production of electron pairs (positive and negative) is shown to occur by materialisation of γ-rays in conformity with Dirac's theory, from Mg, Al, S, Cu, Zn, Sn and Pb. C. A. S.

2739. Sudden Changes in Velocity and Direction of Trajectories of Electrons of Great Energy. L. Leprince-Ringuet. *Comptes Rendus,* 200. *pp.* 1524–1526, *April* 29, 1935.—The trajectories of electrons of energies $1 - 10 \times 10^6$ eV were obtained by means of a source of Rd-Th and Be enclosed in 13 cm. Pb, and a Wilson chamber in which were placed plates of Al, $0 \cdot 7$ or $1 \cdot 5$ mm. thick, and/or Ag, $0 \cdot 5$ mm. from which the trajectories were reflected or initiated. A magnetic field of 1400 gauss was applied and the trajectories observed stereoscopically. Seven are reproduced and described. C. A. S.

***2740. Electron Diffraction Camera. L. H. Germer.** *Rev. Sci. Instruments,* 6. *pp.* 138–142, *May,* 1935.—An electron diffraction camera designed for the study of surfaces by the reflection method is described. Flexible copper bellows are used to produce motions inside the evacuated container. The current may be varied from 3×10^{-11} to 3×10^{-9} ampere, the larger values being used for rough surfaces. The time of exposure of the photographic plate is about 10 sec. F. C. C.

2741. Theory of Electron Microscope Using Purely Magnetic Fields. R. Wallauschek and P. Bergmann. *Zeits. f. Physik,* 94. 5–6. *pp.* 329–347, *April* 2, 1935.—The general differential equations of the electron paths in axial symmetrical fields are derived and are applied to the study of a particular case in which a purely magnetic field is considered under paraxial conditions. Image formation in magnetic fields is discussed and the position of the principal points under certain simple conditions is calculated. H. J. H. S.

***2742. Electron Microscope and its Uses. B. v. Borries and E. Ruska.** *V.D.I.* 79. *pp.* 519–524, *April* 27, 1935.—A brief general account is given of the principles of electron optics and the construction of an electrostatic and a magnetic electron microscope is described. The production of electron-optical images using electrons derived from hot kathodes, photo-sensitive surfaces and secondary emission is mentioned, as well as those obtained by the transmission through thin films of high-speed electrons. A number of important applications of the electron microscope are described and the possibilities of further development are outlined, care being taken to enumerate the difficulties to be overcome before progress is possible. H. J. H. S.

2743. Electron-Optical Observation of the $\alpha \to \gamma$ Transformation in Iron. E. Brüche and W. Knecht. *Zeits. f. techn. Physik,* 16. 4. *pp.* 95–98, 1935.—The application of the electron microscope to the study of transformations occurring in iron is continued [see Abstract 480 (1935)]. Electron-optical images of the surface of a pure iron kathode are obtained and the recrystallisation which occurs as the iron is heated is visually observed; simultaneously the temperature of the iron is measured with an optical pyrometer and also with a thermoelement. It is shown that recrystallisation occurs at a definite critical temperature which is given as 907° C. on heating and 898° C. on cooling, these temperatures being accurate to ± 1° C. If it is assumed that the recrystallisation temperature is the same as that at which the transformation takes place, then the temperatures given refer also to those of the $\alpha \rightarrow \gamma$ phase transition. H. J. H. S.

***2744. Retrograde Rays in the Kathode-Ray Oscillograph. E. W. Freisewinkel.** *Arch. f. Elektrot.* 29. *pp.* 272–280, *April* 5, 1935.—Reports and explains some phenomena associated with retrograde rays in the kathode-ray oscillograph and compares the ability of magnetic and electrostatic beam traps to prevent their passage. E. W.

See also Abstracts **2324, 2412, 2420, 2421, 2538, 2673, 2682, 2698.**

ELECTROSTATICS.

See Abstract **2619.**

GALVANOMAGNETIC AND THERMOMAGNETIC EFFECTS.

2745. Hall and Magneto-Resistance Effects. D. Shoenberg. *Cambridge Phil. Soc., Proc.* 31. *pp.* 271–276, *April*, 1935.—Recently Kohler [see Abstracts 5236 and 5237 (1934)] on the basis of some experiments by Verleger, has questioned the validity of the usual assumption that the linear Hall effect is entirely perpendicular to the current. The available experimental data are contradictory, however, so a simple magneto-resistance experiment with a bismuth crystal was made, which suggested that the usual assumption was, after all, valid. The dissymmetry of the Hall effect is discussed, and some of Kohler's results are generalised. AUTHOR.

2746. Hall Effect and Other Physical Constants of Bi-Cd Alloys. S. Gabe and E. J. Evans. *Phil. Mag.* 19. *pp.* 773–787, *April*, 1935.—Using alloys of Cd and Bi which had been carefully annealed (which reduces the resistivity) the resistivity at 0° (*a*), mean temperature coefficient of resistance 0–100° (*b*); thermoelectric power against Cu, 12–100° (*c*); density at 16° (*d*); Hall effect, 3096–8424 gauss (*e*); and specific heat, 19–100° (*f*) have been plotted against composition. The curves for (*d*) and (*f*) are accurately straight lines, those for the other properties are continuous curves, giving no indication of any combination or solid solution between the constituents, the alloys consisting of mixed crystals. Curves for (*e*) are very steep towards the Bi end, and for increasing strength of field show decrease in the absolute value of the (negative) coefficient. The variations in (*a*) and (*e*) support the electron theory for these properties. [See Abstract 1331 (1934).] C. A. S.

MAGNETISM AND ELECTROMAGNETISM.

2747. Energy of Two Laminæ in Polarisable Medium. J. Cayrel. *Comptes Rendus*, 200. *pp.* 1093–1094, *March* 25, 1935.—The problem of 2 identical laminæ, infinitely doubly distant, is again considered [see Abstract 1857 (1935)], this time the displacing work being performed in a polarisable medium of permeability μ. Poisson's theory is invoked and the conditions of the equivalent transformation carried out are categorically defined. Work done by magnetic forces is μ times what it is *in vacuo, i.e.*, the forces are themselves multiplied by μ as in the case of two currents. J. E. B.

2748. Weiss Constant of Paramagnetic Ions in the S-State. Part I. Aqueous Solutions of Manganous Salts. A. Bose. *Indian Acad. Sci., Proc.* 1. *pp.* 605–615, *March*, 1935.—Theory has predicted that the susceptibilities of paramagnetic ions in the S-state, *e.g.*, Mn++, should follow the simple Curie law of temperature dependence. This has been confirmed for solid manganous and ferric salts, but experimental data for aqueous solutions conform to the Weiss relation. An account is given of measurements on aqueous solutions of $MnCl_2$, $Mn(NO_3)_2$ and $MnSO_4$ by Gouy's method. The data obtained for the susceptibility of the Mn++ ion conform to the simple Curie law, and the Curie constant is practically the same for all the solutions. It is independent of the nature of the salt and of its concentration, and corresponds to a magnetic moment of 29·3 to 29·4 Weiss magnetons, thus agreeing with the theoretical value for the $^6S_{5/2}$ state, viz., 29·4. G. E. A.

2749. Experimental Properties of Paramagnetic Substances. G. Dupouy. *Comptes Rendus*, 200. *pp.* 1308–1310, *April* 8, *and pp.* 1385–1387, *April* 15, 1935.—The assumption that paramagnetic substances in general consist of two or more magnetically simple varieties differing only in values of θ and C (in the expressions for the Curie and Weiss laws, $\chi T = C$, and $\chi(T - \theta) = C$) explains several hitherto inexplicable facts, *e.g.*, sudden breaks in the $1/\chi - T$ curve, and different values of δ and C for the same substance. It also makes it possible to deduce the Curie law as a special case of that of Weiss. [See Abstract 1392 (1932).] It is further shown to explain why the transformation point is independent of the magnetic constants of the mixture and depends solely on those of the constituents; and that the variation in atomic moment is discontinuous, with the consequent result that there are only a finite number of different magnetic varieties. **Errata,** *ibid.*, *p.* 1696, *May* 13, 1935. C. A. S.

2750. Magnetic Susceptibility of Cadmium Compounds. W. R. A. Hollens and J. F. Spencer. *Chem. Soc., J. pp.* 495–496, *April*, 1935.—The mass susceptibilities of 30 cadmium compounds are recorded. The atomic susceptibility of cadmium is found to be $-24{\cdot}85 \times 10^{-6}$. Cadmium borofluoride is described. Susceptibility values for the groups $(C_6H_5{\cdot}NH_2 + I')$, BF_4', $CH_2(COO)_2'$, $N_2H_5{\cdot}SO_4'$, C_9H_6ON, IO_3', BrO_3' are given. AUTHORS.

2751. Magne-Crystallic Action. Part III. Organic Crystals. K. S. Krishnan and S. Banerjee. *Roy. Soc., Phil. Trans.* 234*A*. *pp.* 265–298, *May* 29, 1935.—In the present part a new method is described of measuring the magnetic anisotropies of crystals, which can be adopted for even such small crystals as weigh only a fraction of a milligram. By this method the principal susceptibilities of a large number of organic crystals, specially selected for their structural interest, have been determined. For many of them the molecular orientations in the crystal lattice are deduced from the magnecrystallic data, and are in general found to agree with the X-ray determinations. The principal susceptibilities of individual molecules have also been computed for a number of compounds. [For Parts I and II see Abstracts 2616 and 3825 (1933).] AUTHORS.

2752. Limitations of Crystal Symmetry on Physical Phenomena with Particular Reference to Diamagnetic Magnetostriction. D. Schoenberg. *Cambridge Phil. Soc., Proc.* 31. *pp.* 265–270, *April*, 1935.—A direct method of obtaining the limitations of crystal symmetry on physical phenomena is described and discussed in greater detail for the case of diamagnetic magnetostriction. Formulæ are obtained for the variation of the longitudinal and transverse effects with crystal orientation in the case of bismuth. [See Abstract 3435 (1932).] AUTHOR.

2753. Position of Research in Gyromagnetism. O. v. Auwers. *Naturwiss.* 23. *pp.* 202–210, *March* 29, 1935.—Four distinct gyro-mechanical effects are noted as having been the objects of research hitherto: (1) macroscopic gyro-effect of rotation of the whole body (Maxwell, 1861); (2) atomic gyro-effect of rotation of the elementary magnet by rotation of the whole body (Barnett, 1909–1914); (3) atomic gyro-effect of rotating the axis of the elementary magnet (Richardson, Einstein-de Haas, 1908–1915); (4) atomic gyro-effect of rotation of the elementary magnet (Tonks 1921, Fisher 1922). Other four possible modifications are considered, and the eight are tabulated as forming the basis of experiments for direct proof of the gyrostatic nature of the atom. Two basic experiments with a counterpoised gyrostat are described in which the action of a couple (1) causes a change in the orientation of the axis of rotation of the gyro, and (2) causes the gyro to precess. The four effects mentioned are discussed in relation to these basic effects and an explanation is given of the negative result of Fisher's experiment. After shortly discussing the other four possibilities, it is shown that the relation of angular momentum, p, to magnetic moment, μ, of the electron requires the addition of Landé's factor, g, to obtain the p/μ value found experimentally for nearly all ferromagnetic substances. The values of g for different materials are reviewed, and it is pointed out that the theoretical p/μ value for the electron depends on the particular structure chosen for the model of the electron. G. E. A.

2754. Gyromagnetic and Electron-Inertia Effects. S. J. Barnett. *Rev. Modern Physics,* 7. *pp.* 129–166, *April,* 1935.—A comprehensive account is given of two closely related electromagnetic phenomena; accordingly, the paper is divided into two parts, the first part dealing with gross magnetic or dynamical phenomena, *i.e.*, gyromagnetic effects, and the second with gross mechanical or electrical phenomena in conductors and insulators attributable to the electron inertia. In Part I the development of the subject is traced historically and qualitative discussions are given of the 4 gyromagnetic effects, viz., the gross magnet as a gyrostat (Maxwell's experiment), magnetisation by rotation (Barnett effect), rotation by magnetisation (Einstein and de Haas effect) and gyroscopic magnetisation by the rotation of a magnetic field. The gyromagnetic ratios for several types of magnetic element are deduced. The quantitative theory of these 4 effects is then given, followed by a description of the experiments and results obtained by the numerous workers in this field. In Part II the inertia effects first described by Maxwell and investigated experimentally by him and his followers are briefly considered. The centrifugal experiments of Lébedèw and Nichols and the ballistic experiments of Tolman and Stewart are discussed, followed by those of Tolman and his co-workers. Finally, the work of Barnett on electron inertia is described. H. J. H. S.

2755. Gyromagnetic Effect in Ferromagnetic Substances above the Curie Point. W. Sucksmith. *Helv. Phys. Acta,* 8. 2. *pp.* 205–210, 1935. *In German.*—The magnetic moment of the Ni atom is not the same below and above the Curie point (0·6 and 1·6 Bohr magnetons). Measurement of the gyromagnetic effect below the Curie point shows that the magnetism of the Ni atom depends only on electron spin. The measurements carried out prove that, in the paramagnetic condition above the Curie point, the Ni atom in Ni-Cu alloys exhibits pure spin magnetism.

The Landé g factor was determined for these ferromagnetic alloys above their Curie points, and the value found, viz. $g = 2$, excludes any effect due to orbital momentum. In these alloys, the Ni atom has the same magnetism as in pure nickel. [See also Abstract 4110 (1930).] G. E. A.

***2756. Optical System for Shadow Recording with Oscillographs. G. A. Woonton and F. W. Pye.** *Canad. J. of Research*, 12. *pp.* 261–264, *Feb.*, 1935.—In this paper is discussed a method of shadow recording for use with reflecting types of oscillographs which simplifies the methods of obtaining time and amplitude rulings on the record. The optical system is rendered portable by the use of a low-intensity light source, compensated by high transmission efficiency. Comparative records indicate that, when used in conjunction with bromide paper, this optical system is of value in recording sinusoidal currents whose frequencies are below 20 cycles, or currents of complicated wave form whose fundamental frequency is well below 20 cycles. No data relative to records on moving film are reported. Mann, in discussing a new portable electrocardiograph, has referred to an optical system of this type. The authors believe that the present paper contains sufficient new information on the details of construction and operation of this optical system to make it of value. AUTHORS.

***2757. Electromagnet of Uppsala University. L. Dreyfus.** *A.S.E.A., J.* 12. *pp.* 8–16, *Jan.–March*, 1935. *E.u.M.* 53. *pp.* 205–211, *May* 5, *and pp.* 218–221, *May* 12, 1935.—The new electromagnet of the University of Uppsala was built by the A.S.E.A. It is the most powerful magnet at present in existence. The author compares this magnet with those of the Leyden University and of the French Academy of Science, which latter is the largest magnet in the world. The Uppsala magnet has a power (flux density for given gap volume) which is about 10 % in excess of that of the giant French magnet, yet the weight of the former is a bare 30 % of that of the latter. This striking superiority is due mainly to the theoretically correct design of the pole-cores of the Swedish magnet. Its superiority over the Leyden magnet is even more marked. The flux density in the Uppsala magnet falls in passing from the pole-pieces to the pole-block and the frame. The apex angle of the pole-pieces is 120°, while that of the conical core is nearly 90°. With 500,000 ampere turns and a gap volume of $\pi \times 0.5 \times 6$ cm^3 the flux density in the gap is about 63,000 lines. The magnet is mounted on a turntable and can also be tipped 90° to the horizontal. The continuous loading is 140 kW (84V) and it weighs 33 tons (the complete equipment). G. K.

2758. Magnetism. Part I. R. Becker and R. Landshoff. *Die Physik*, 3. 2. *pp.* 91–108, 1935.—The authors review the rapid development of knowledge of magnetism which has taken place more particularly during the last eight years, brought about by the discovery of electron spin and the application of quantum mechanics. More exact calculations were made possible, especially in dia- and para-magnetism, with consequent reaction on experimental investigations. The demands for improved quality of magnetic material in electrotechnics has also led to numerous researches and to a deeper insight into the process of magnetisation. The subjects treated are : diamagnetism, ionic susceptibility ; paramagnetism, rare earths, the iron group, Pd-, Pt- and U-transition groups, homeopolar molecules and combinations of compound ions ; para- and dia-magnetism of metals ; ferromagnetism, general theory, gyromagnetic effects, the magnetisation curve, its different parts. Heusler and related alloys, magnetisation and resistance, Bitter's strips, permeability and frequency, magnetic after-effect. Reference is made throughout to the volume and page in the *Physikalische Berichte* where the reports of the numerous papers consulted are to be found. G. E. A.

See also Abstracts 2337, 2385, 2526, 2537, 2638, 2696, 2697, 2777.

MEDICAL RADIOLOGY AND ELECTROLOGY.

***2759. Radio-Frequency H.V. Apparatus for X-Ray Therapy. R. S. Stone, M. S. Livingston, D. H. Sloan and M. A. Chaffee.** *Radiology*, 24. *pp.* 298–302, *March*, 1935.—Describes tests carried out upon a h.f. X-ray apparatus previously described [see Abstract 2288 (1935)]. With the enclosed design of this particular apparatus, it is not possible to utilise a spark gap to determine the peak voltage. The method adopted is by absorption of the radiation emitted *via* Pb and Al. In respect to Pb absorption, photoelectric effects occur and, whilst the method is less convenient to estimate the equivalent voltages, the method has application to compare the operation of different X-ray tubes. Curves obtained are compared with similar h.v. X-ray radiation curves obtained by Lauritsen and Coolidge. Curves are also given for the equivalent voltage as obtained by use of Al and these are discussed in respect to the constant potential equivalent. The advantage of the apparatus described over more commonly used apparatus is that a grid-bias can be applied, to assure that only high speed electrons reach the X-ray tube target, so that the quality of radiation can be controlled. The measurements show that a peak voltage of at least 850kV is obtained with the apparatus previously described and, by the application of a grid-bias voltage to the kathode filament shield, the operating characteristics simulate those of a constant potential apparatus, the grid-bias resulting in a reduced amount of emission current to obtain the same *r* output, as the beam quality is improved. B. J. L.

2760. Electrical Characteristics of Constant H.V. Generators for X-Ray Work. Part II. Practical Observations on Half-Wave Generators. G. E. Bell. *Brit. J. of Radiology*, 8. *pp.* 218–226, *April*, 1935.—In a previous paper [see Abstract 5079 (1934)] it was shown theoretically that the currents charging the condensers of constant voltage generators were usually comparatively small. This conclusion is verified in the present paper. The peak values of the charging currents were measured by means of a simple apparatus comprising a rectifier, condensers and electrostatic voltmeter, and it was found that the peak current is about six times the current through the X-ray tube. At the moment of switching on the generator higher currents arise, and instantaneous values up to 100 mA were recorded. G. E. B.

***2761. X-Ray Protection. Part IV. E. I. L. Cilley, B. R. Kirklin and E. T. Leddy.** *Am. J. of Roentgenology and Radium Therapy*. 33. *pp.* 390–395, *March*, 1935.—Continuation of previous papers [see Abstract 1867 (1935)] and discusses the dosage received by the finger tips during the diagnostic procedure of X-ray palpation. It is shown that the tips of the fingers receive a dose of X-rays about three times as great as the dose to the rest of the hand and that this is minimised by the use of a small field of irradiation and observation. The methods of measurement used in the investigation must necessarily lead to wide variation of results, but show that correct technique of examination is of basic importance to prevent injury of the hand. B. J. L.

***2762. Experimental Realisation of the International " r " Unit. W. H. Love.** *Brit. J. of Radiology*, 8. *pp.* 252–258, *April*, 1935.—The standardising equipment used in the Cancer Research Department of the University of Sydney is described. The ionisation chamber is of the parallel plate type, the h.v. generator is a 250 kV constant voltage outfit, operating a water-cooled Muller X-ray tube. The ionisation current is measured by a ballistic method, and the various possible sources of error, such as field distortion, and leakage are considered. G. E. B.

2763. Physical Determination of Radium Dosages. O. Glasser. *Am. J. of Roentgenology and Radium Therapy*, 33. *pp.* 293–295. *March*, 1935.—Whilst the international " r " unit has been adopted for the measurement of X-ray dosage, in spite of the radiation from radium being of a more permanent nature, no similar satisfactory unit yet exists for radium radiation. Specification of dosage as " milligram-element-hours per centimetre " has been employed in the past and is still utilised. Various other standards have been proposed. The author discusses the method based upon ionometric measurement under standard conditions given. referring to the work in Germany and Britain in this respect. Calculation of the radiation intensity at 1 cm. from 1 gm. element per hr. gives an equivalent to 7·35 R, this value being identical to measurements made over a number of years and recently confirmed by Mayneord in England and Jaeger in Germany. B. J. L.

2764. Physical Factors in Teleradium Therapy. W. Stenstrom. *Am. J. of Roentgenology and Radium Therapy*, 33, *pp.* 296–301, *March*, 1935. —The distribution of radiation from a radium applicator, apart from purely biological considerations, depends upon the physical data of radium-skin distance, filtration, distribution of the radium in the applicator, secondary radiation from the applicator and changes of radiation in the tissues. The intensity of radiation from a container, fitted with a filter, is discussed on a mathematical basis. B. J. L.

2765. Physical Factors in Intracavity Radium Therapy. J. L. Weatherwax. *Am. J. of Roentgenology and Radium Therapy*, 33. *pp.* 302–305, *March*, 1935.—The distribution of irradiation intensity in the vicinity of a radium applicator for use in body cavities is discussed on the basis of isodosis curves. It is found that under practical conditions in certain intracavity lesions, it is impossible to deliver a lethal dose throughout the entire lesion with radium only and it is necessary to combine the radium treatment with X-ray treatment, preferably at approximately the same time for satisfactory results. B. J. L.

2766. Physical Factors in Interstitial Radium Therapy. E. H. Quimby. *Am. J. of Roentgenology and Radium Therapy*, 33. *pp.* 306–316, *March*, 1935.—It is difficult to obtain correct values of the radiation intensity and dosage from radium needles when used in deep tissues. The present paper gives tabular data and curves relating to a method whereby the minimum dose of radiation can be calculated for any practical scheme of needle implantation. The method used employs a phantom formed by a block of wax, which is attached to the skin of the patient and within which is imbedded a radium needle of known value at any stated distance from the patient's skin. By this means the physical data as to time, etc., can be determined in respect to erythema production upon the skin and is related to the distance from the skin. As a result it is possible to determine the dosage at any given depth of the wax and, from the curves which are calculated, the doses delivered to certain points in the neighbourhood of groups of needles of different lengths have been calculated, making it possible to determine the minimum tissue dose delivered in a given mass from a specified irradiation for any type of radium needle in general use. B. J. L.

2767. Alloy for Use in Radium Beam Therapy. J. C. McLennan and C. J. Smithells. *Journ. Sci. Instruments*, 12. *pp.* 159–160, *May*, 1935.—A tungsten-nickel-copper alloy of density 16·5 is described, which has a mean absorption coefficient for hard γ-rays of 0·83 cm.$^{-1}$ Details of the method of preparing the alloy are given. AUTHORS.

See also Abstract 2613.

OSCILLATIONS.

See Abstracts 2391, 2691.

PHOTOELECTRICITY.

2768. Schottky Effect in Photoelectric Elements with Blocking Layers. G. Liandrat. *Comptes Rendus*, 200. *pp.* 1311–1312, *April* 8, 1935.—A short discussion is given of the possible causes of the observed increase of photoelectric current by the application of increasing accelerating potentials to a selenium blocking-layer element. Reference is made in particular to measurements of the total photoelectric emission, using a calibrated tungsten band lamp as source and modulating the light at a frequency of 500 ∼. The Richardson-Suhrmann straight lines are plotted for a series of accelerating potentials proportional to the squares of the whole numbers. Hence it is found that the corresponding values of the work function for the interface semi-conductor-blocking layer form an arithmetical progression. This is in accordance with the Schottky equation, and is taken as evidence that the phenomenon is analogous to the Schottky effect. L. A. W.

2769. Influence of External Field on Photoelectric Effect with Cæsium Oxide Kathodes. R. Fleischer and P. Görlich. *Zeits. f. Physik*, 94. 9–10. *pp.* 597–606, *April* 16, 1935.—The various influences of space-charge and external field on the photoelectric effect, as investigated by various authors, are reviewed. The authors give their results for spectral sensitivity curves, taken with and without an accelerating potential on Cs–O kathodes; a shift of the long-wave maximum towards longer wave-lengths occurs. In Cs–O kathodes with alkali metal atoms included, and with hydrided alkali metal kathodes deposited in bulk, no such shift is observed. D. H. F.

2770. Photoelectric Fatigue and Oxidation. J. S. Hunter. *Phil. Mag.* 19. *pp.* 958–964, *May*, 1935.—The photoelectric thresholds of oxidised Cu, Ag, Bi and Ni were measured. All were found to lie on the short-wave side of the threshold for fully outgassed surfaces of the same metals. It has previously been shown [see Abstract 3430 (1934)] that if a clean metallic surface is exposed to the air for a few minutes its photoelectric threshold moves towards longer wave-lengths. The author therefore infers that, contrary to the opinions of other workers, an oxide film is not formed instantaneously on a clean metallic surface exposed to air: he considers that it is more likely that the surface immediately begins to adsorb gas. D. H. F.

2771. Cuprous Oxide Photo-Cells. C. G. Fink and M. E. Fogle. *Am. Electrochem. Soc., Trans.* 66. *pp.* 271–319; *Disc.*, 319–322, 1935.—Results are given of numerous tests showing how the cell characteristics depend upon temperature, intensity of illumination, external and internal resistances, p.d. between electrodes, medium around the cell, pre-treatment of oxide surface, and various physical factors. The authors consider to be erroneous the belief that photo-current generation in this type of cell is more fundamental than voltage generation. Experiments to show that the cell resistance does not necessarily vary with intensity of illumination are described. It is shown that coating the surface with a film of an inert transparent material reduces the loss of light by reflection at the surface, thus effecting an increase of 15–20 % in the efficiency of the cell. A general comparison, under varied conditions, is made of these cells with liquid photovoltaic cells. D. H. F.

2772. Action of Gases on Dye Photo-Cells. Cécile Stora. *Comptes Rendus*, 200. *pp.* 1191–1194, *April* 1, 1935.—Experiments on the action of H, N, and O on photosensitive electrodes of Pt dyed with Nile blue, methylene blue, or brilliant green show that the negative potential produced with O is diminished or inverted with N, and becomes strongly positive with H. Whatever theory may be held as to the origin of the colour, light acts on that group in the portion of the molecule responsible for the colour, to which is also attributed the oxidation-reduction equilibrium. [See Abstract 1878 (1935).] C. A. S.

See also Abstracts 2603, 2637, 2692, 2778.

PIEZOELECTRICITY.

2773. Electrification by Torsion of Piezoelectric Bodies. P. Langevin and J. Solomon. *Comptes Rendus*, 200. *pp.* 1257–1264, *April* 8, 1935.—Contrary to the opinions expressed by Ny Tsi-Ze and Tsien Ling-Chao and by Tawil relating to the "strephoelectric" character of the electrification produced by the torsion of a quartz crystal [see Abstracts 2309 and 2310 (1935)], the authors consider that the phenomenon is piezoelectric in character and that the existence of such a phenomenon is to be anticipated from Voigt's theory of piezoelectricity. [See following Abstract.] J. S. G. T.

2774. Electrification by Torsion of Quartz and the Reciprocal Phenomenon. E. P. Tawil. *Comptes Rendus*, 200. *pp.* 1306–1308, *April* 8, 1935.—Experiments are briefly described indicating that strephoelectrification and piezoelectrification shown by quartz crystals are two distinct and different phenomena. [See preceding Abstract.] J. S. G. T.

2775. Frequency-Temperature Characteristics of Quartz Plates of Zero Temperature-Coefficient. I. Koga and M. Shoyama. *Comptes Rendus*, 200. *pp.* 1224–1227, *April* 1, 1935.—In a quartz plate whose faces are parallel to the electric axis, the so-called thickness vibrations are pure shear vibrations [see Abstract 804 (1933)]. The temperature coefficient of frequency is zero at a certain temperature when the co-latitude of the faces, *i.e.*, the angle between the optic axis and the normal to the faces, is roughly 55° or 138°. The temperature at which the coefficient is zero depends on the exact value of the co-latitude. P. V.

See also Abstracts 2350, 2400, 2667.

THERMIONICS.

2776. Thermionic Electron Emission and Adsorption. Part I. Thermionic Emission. J. A. Becker. *Rev. Modern Physics,* 7. *pp.* 95–128, *April,* 1935.—A critical review is given of the theoretical investigations of thermionic emission and how the various formulæ are supported by experimental results. It is shown that the work function depends on temperature and that also the crystalline nature of the body may give a surface area quite different from the apparent area and so constants differing widely from the theoretical values. By the quantum mechanics it is seen that reflection effects may occur. Since most kathodes are covered with patches having varying work functions above and below the mean value, a method called the hill and valley checker-board is shown by which the function can be investigated and electron-micrographs and photomicrographs are reproduced which support the results of the method. Values of work functions for many elements with clean surfaces are tabulated and show that the thermionic and photoelectric work functions are the same. The effects of Maxwellian and Fermi-Dirac distribution of velocity are considered. H. M. B.

See also Abstract 2778.

THERMOELECTRICITY.

2777. Thomson Effect and Ferromagnetism. N. Tunazima. *Phys. Math. Soc., Japan, Proc.* 17. *pp.* 119–126, *April,* 1935. *In German.*—The Thomson effect of ferromagnetic bodies is variable with the temperature similarly to the specific heat in the neighbourhood of the critical temperature. From particular lengths of free path of the electrons, which are dependent on the exchange energy (spontaneous magnetisation), this anomalous Thomson effect of ferromagnetic bodies is deduced. Various investigators have shown the sudden great increase and soon the decrease of the Thomson effect in the neighbourhood of the Curie temperature point. From these experiments it has been considered that ferromagnetism subsists in free electrons but not in bound electrons. The author deduces on other grounds a new theory of the Thomson effect in ferromagnetic bodies. Through the e.m.f. produced by the unhomogeneity of temperature free electrons run through the lattice and fulfil the work which the heat develops. This heat consists of irreversible and reversible portions. The reversible heat is called the Thomson heat. The Thomson coefficient is dependent on the free path of the free electrons. In ferromagnetic bodies the free paths are dependent on spontaneous magnetisation and therefore the Thomson coefficient must show a characteristic dependence on the spontaneous magnetisation. J. J. S.

2778. Glow-Electric Effect of Hydrogen-Charged Pd-Ag Alloys. J. Schniedermann. *Ann. d. Physik,* 22. 5. *pp.* 425–442, *April,* 1935.—Absorbed H raises the glow-electric emission of all Pd-Ag alloys. The alloy 60 % Pd-40 % Ag shows an absolute minimum analogous to the curves for conductivity and Hall effect of gas-charged Pd-Ag alloys. Parallelism with the curve of electrolytic H absorption does not exist. The raising of the glow-electric emission in consequence of H absorption depends upon an increase of the number of free electrons and upon a reduction of the egress work. The change of the egress work chiefly determines the course of the emission curve. [See Abstract 4566 (1932).] J. J. S.

See also Abstract 2746.